ELECTRICAL REVIEW

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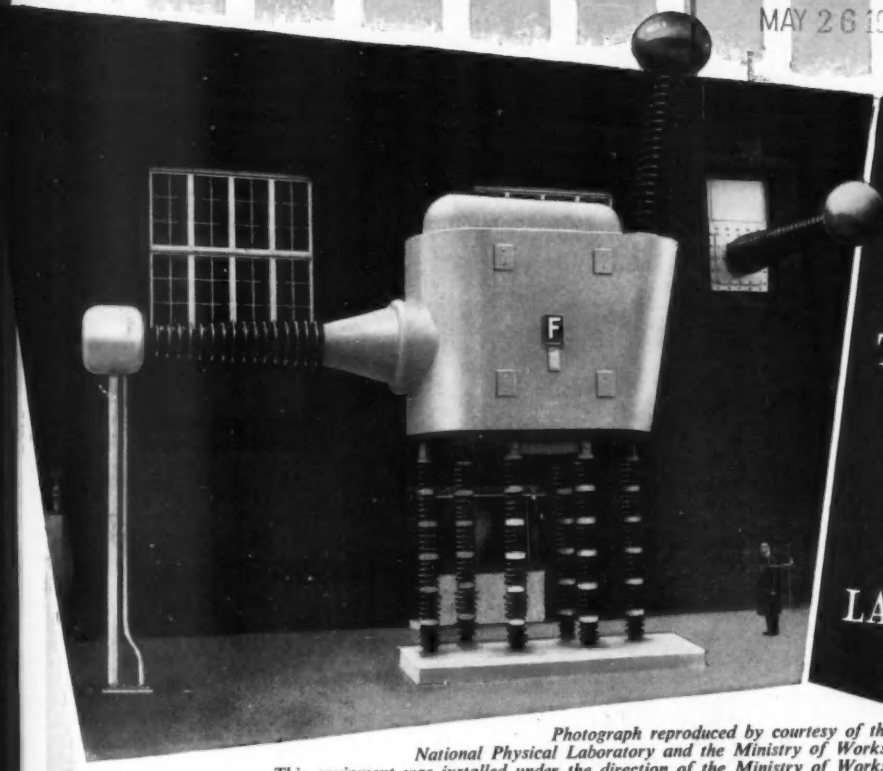

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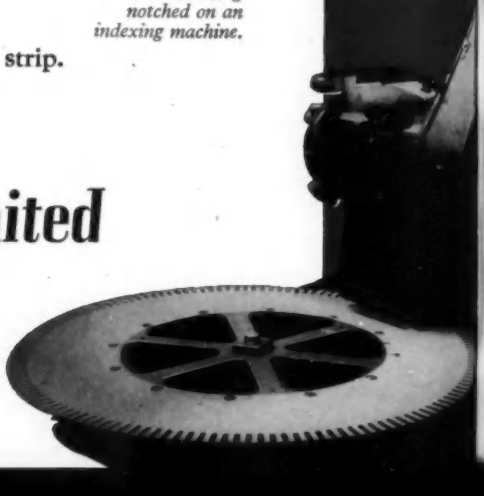

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ELECTRICAL REVIEW

8 May 1959 Vol. 164 No. 19 Established 1872

Nuclear Achievement

EARLIER this year the second large scale nuclear power plant to go into operation anywhere in the world commenced generating electricity on a commercial basis. We refer, of course, to the Chapelcross nuclear generating station of the United Kingdom Atomic Energy Authority which is being built near Annan in Dumfriesshire. This plant, which is described in this issue, is almost identical to that installed at Calder Hall (see *Electrical Review*, 19th October, 1956), but some minor changes have been made as a result of operating experience gained with the now world-famous installation. It is anticipated that the Chapelcross station will be completed towards the end of this year and this will mean that there will then be 368 MW of nuclear generating plant in operation in the United Kingdom—a far greater amount than in any other country in the world.

Although Calder Hall and Chapelcross are of basically the same design there are big differences in general station layout. The construction plan for Chapelcross demanded a four reactor station *ab initio* so the reactors were conveniently built in line, this arrangement permitting a single large turbine house with four adjacent cooling towers. A very compact arrangement is thus achieved compared with the spread out " A " and " B " station layout of Calder Hall, which should simplify operation and maintenance.

Perhaps the most important change in design concerns the introduction of removable graphite sleeves into the fuel channels to avoid the stored energy problems associated with irradiation damage of the graphite moderator —the " Wigner effect." When a reactor is in operation moderator atoms can be displaced by fast neutrons and, in the absence of annealing, these displacements are permanent and bring about changes in physical properties. One method of overcoming the problem is to raise the temperature of operation of the reactor but this could not be done at Chapelcross owing to temperature limits on such items of plant as blower casings and inlet ducts. The sleeve method which has been adopted involves a small gap between the sleeves and the bulk of the graphite. This becomes filled with cooling gas and acts as a thermal insulation barrier, thus ensuring that the bulk graphite temperature is raised above its normal value and providing some measure of self-annealing.

There has been a certain amount of criticism from abroad of the British policy of adhering to the graphite-moderated gas-cooled reactor as a source

of power. The two large plants which we now have in operation, however, prove that the choice was a sound one. Calder Hall was put into commission as easily as a conventional plant and it has now been working for over two years in a highly satisfactory manner, and it has proved to have greater flexibility over most of its operating range than was originally expected. On this record of solid achievement the Central Electricity Generating Board can expect success in its important programme of nuclear power plant construction and, before very long, the capacity of these generating stations will be measured in thousands of megawatts.

GRANTS TO STUDENTS

In its recommendations to the Anderson Committee on Grants to Students the Federation of British Industries urges that the present " means test " should be replaced by adding a proportion of the scholarship award to the parents' taxable income. As Mr. W. H. McFadzean, president of the Federation, said last week, university fees should be paid out of public funds without a parental contribution but the F.B.I. supported the principle of parents sharing the cost of maintenance.

The matter is of immediate and serious concern to British industry which increasingly looks to the universities and other institutions of higher education for the supply of its future executives and professional staff. There is increasing evidence that the means test is having a serious effect on parents in the middle income range who are turning in large numbers to industry for the further education of their children. Financial considerations should not be allowed to deflect men of university calibre to other types of further education. It is a very short-sighted policy to deprive of a university education any young persons who have given good evidence that they are likely to benefit from it, and children who have been awarded grants have given this evidence.

THE ADVANCEMENT OF SCIENCE

The British Association for the Advancement of Science, whose 121st annual meeting takes place in York in September, is undoubtedly one of the country's more valuable institutions, playing, as it does, an important part in the proper presentation of the aims of science and its impact upon the general public at a time when nuclear weapons vie with nuclear power. The importance of a complete, accurate and understandable explanation of these aims and the wish of scientists to devote their energies and research projects to peaceful uses cannot be over-emphasised, nor can be the perpetual need to interest youth in scientific pursuits, essential for both this country's industrial well-being and for the physical survival of those people living in the world's under-developed countries. It is appropriate, therefore, that the theme chosen by the Association's president, Sir James Gray, in his address presents science not as a subject confined to the laboratory and classroom but as an essential part of our culture.

The continuous showing of scientific films and the programme of lectures for students from schools in the York area will also be of great value ultimately for the electrical industry for, although dinosaurs and Darwin may not appear to be so germane to our profession as is atomic energy, it is essential that scientifically-minded youth should be given the broadest possible introduction to science, ensuring that those who subsequently specialise in electrical engineering possess the necessary width of outlook.

MINISTERIAL INEPTITUDE

The provision of a hospital for the Wythenshawe estate, Manchester, is said to be held up by the insistence of the Manchester Corporation that heating should be by gas or electricity. Until the Hospital Board gives an undertaking to this effect the Corporation will not lease it the necessary land. The *Manchester Guardian* places the blame mainly on the Ministry of Health who chose to regard a coal-fired boiler plant with a chain grate stoker as sufficiently smokeless as to warrant exemption from the provisions of the Clean Air Act. " The Ministry was also the source of the still more astonishing notion that heat from electricity costs nearly six times as much as heat from coal."

The *Guardian* quite rightly points out that this estimate made no allowance for the relative changes in costs since before the war or for the heat losses entailed in the use of a coal-fired central boiler. It goes on to show that, taking everything into consideration, it is possible that the gap is narrowed " possibly to vanishing point." What basis the Ministry had for its assertion is unknown for apparently the North Western Electricity Board has not yet had an opportunity of preparing a detailed estimate and so real figures are not available.

HOURS AND WAGES

Considering that it is the trade union leader's main task to get more money for his members, Mr. W. J. Carron's expression of views at last week's annual conference of the Amalgamated Engineering Union may be considered very moderate in tone. Mr. Carron fully appreciated that to claim higher wages at a time when prices are comparatively stable would not be regarded as reasonable. Instead he turned his attention to shorter hours.

The main arguments in favour of the proposed 40-hour week (to be introduced by stages) are increased productivity and the existence of unemployment. As to the first, the evidence is not very strong. The employers contend that the rise in productivity has been more than neutralised by increases in wages so that little price advantage has been achieved. Unemployment in the engineering industry, on Mr. Carron's own showing, is proportionately low—only about 0·4 per cent—and overtime is still prevalent. Consequently there seems to be no case on this ground.

Although to aim at a shorter working week is legitimate, for it is bound to come eventually, in present circumstances it would look like an endeavour to secure higher wages by an indirect method. In any case the conference rejected Mr. Carron's advice and adopted motions calling for pressure to secure both higher wages and shorter hours.

Chapelcross Nuclear Generating Station

OFFICIAL OPENING OF CALDER HALL TYPE PLANT

The first reactor and its two associated turbo-alternators at Chapelcross, near Annan, Dumfriesshire, were commissioned in February. When completed later this year, the station will contain four graphite-moderated gas-cooled reactors and eight 23 MW turbo-alternators operating on a dual-pressure steam cycle

As our readers are aware, the world's first large-scale nuclear power plant, the Calder Hall "A" station of the United Kingdom Atomic Energy Authority, began operation on 27th August, 1956, just over three years after site work began. A full description of Calder Hall, with a graphic illustration issued as a supplement, was given in the *Electrical Review* of 19th October, 1956. A year before this station was commissioned, it was decided to build three more units of the same type, one alongside Calder Hall "A" and two units to be sited at a disused airfield at Chapelcross, near Annan, Dumfriesshire.

Construction of the Chapelcross project began in October, 1955, and the first reactor commenced generating on 25th February last. The other three reactors will be commissioned at intervals during the remainder of this year. When complete, Chapelcross will have cost about £34 million, which gives £190/kW compared with about £55/kW for a thermal station. Last Saturday, Sir John Crabbe, H.M. Lieutenant for Dumfriesshire, performed the opening ceremony and unveiled a commemorative plaque. He said that the people of Dumfriesshire were proud to have a nuclear station in their midst. It would help to maintain trade and prosperity in the area.

After the opening ceremony, the general public were allowed to inspect the plant and view exhibitions illustrating the mechanism of the reactor, instrumentation techniques and health physics. In Annan, an exhibition of illustrations and diagrams was held from 30th April to 5th May.

At a Press conference, Lord Plowden, chairman of the U.K.A.E.A., said that since the Windscale accident, the Authority was re-examining its siting policy and would present its conclusions at a forthcoming International Atomic Energy Conference in Rome. However, no new facts had emerged to cause any alteration in the Authority's present siting policy.

With regard to the cost of electricity produced by nuclear fission, it was stated that it would reach parity with that produced by thermal stations by about 1965 and, by 1970, electricity from nuclear power stations should be the cheaper.

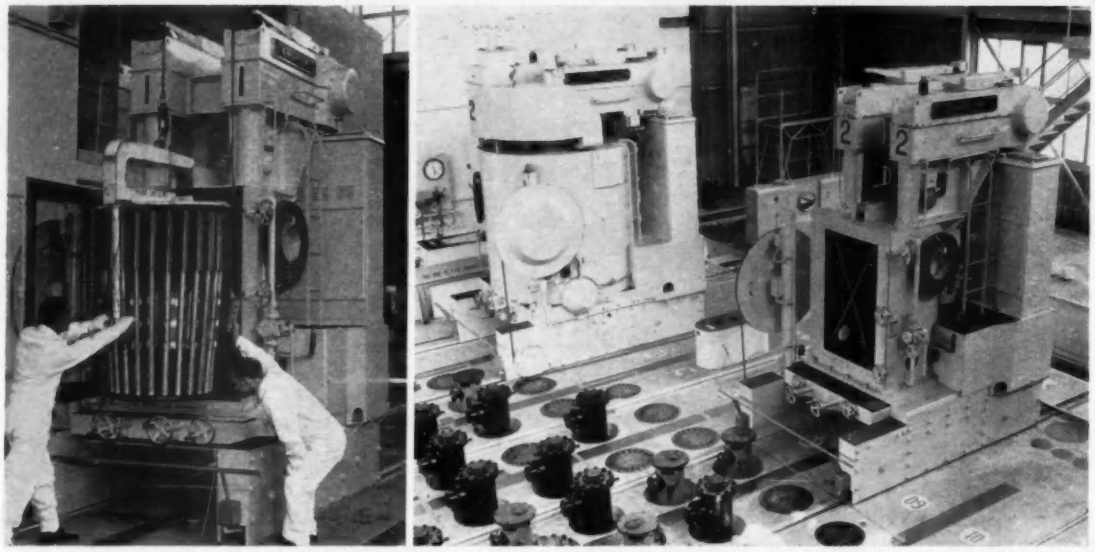
The tariff for electricity produced at Chapelcross was subject to negotiations with the South of Scotland Electricity Board, but Lord Plowden declined to give any figure relating to the tariff agreed with the Central Electricity Generating Board for Calder Hall energy. He recalled that the present chairman of the C.E.G.B. knew full well that electricity was only a by-product at Calder Hall. There were no plans at present for any further plutonium-producing power stations or to extend Chapelcross. There was ample room for additions to Chapelcross and it could be expected that it would be extended.

Comparisons with Calder Hall

The Calder Hall station was designed as a producer of plutonium for military purposes and, with the same aim, Chapelcross is identical, with the exception that graphite sleeves are being provided for the fuel channels in Nos. 2, 3 and 4 reactors. However, the layout of the plant at Chapelcross differs from that at Calder Hall in that the reactors are built in line which permits the use of a single turbine house.

Another departure from the Calder Hall design is a water-filled storage pond for irradiated fuel elements to

Above: Chapelcross power station showing the single turbine hall at the left. The gas blower houses can be seen between the reactor buildings



Left: A charge machine being loaded at one end of the reactor charge floor. Right: Part of the No. 1 reactor charge floor showing a discharge machine on the left and a charge machine on the right

ease the transport problems to the Windscale plutonium factory, which is near Calder Hall, 75 miles away. Chapelcross is situated in south-east Dumfriesshire overlooking the Solway Firth, 3½ miles from Annan. The site is well served by roads and a main London-Glasgow railway runs through Annan.

As already mentioned, the four reactors are in line with the single turbine hall built parallel to them on one side and the four cooling towers parallel on the other side. Each reactor pressure vessel is installed inside a 6in steel thermal shield which is, in turn, inside a 7ft thick octagonal concrete biological shield. Between the two shields is a 6in air gap through which cold air continually flows.

As the subsoil consists of boulder clay overlying round sandstone rock at depths ranging from 25ft to 60ft, the foundations of the biological shields were built directly on to the rock as the raft type foundations used at Calder Hall would not have been suitable for this type of ground. The foundations and the biological shield, which is 90ft high with an internal diameter of 46ft, were constructed in concrete to meet the same rigid specification as called for at Calder Hall but using 75 per cent gravel from local pits with 25 per cent whinstone. When the thermal shield and the pressure vessel were finished, the biological shield was closed by pouring the 8ft thick reinforced concrete pile roof on to permanent steel shuttering set above the top of the thermal shield.

Heat is removed from the reactor by pumping 3,100 tons/hr of CO_2 through it at a pressure of 100 p.s.i. with an inlet temperature of 140 deg C and an outlet temperature of 336 deg C. To maintain this pressure, the whole of the reactor has to be encased in a cylindrical steel tank, the pressure vessel, 2in thick, 37ft in diameter and 70ft high. Four large ducts near the top of the vessel carry the hot CO_2 to the four heat exchangers.

The vessel is of fusion welded construction and consists of five strakes and top and bottom domes of semi-ellipsoidal form. The graphite moderator and associated equipment, weighing approximately 1,400 tons, is supported on a rectangular grid framework, the ends of which terminate on a circular ring girder. The grid itself is supported on twenty brackets equally spaced around the vessel and welded to check plates which, in turn, are welded to the bottom dome. The load is transmitted directly through the vessel wall to an equal number of external support brackets welded to check plates directly opposite the inner brackets. The external brackets also take the load of the vessel itself, which amounts to nearly 500 tons.

The external brackets seat on the rolling surfaces of a number of columns made in the form of inverted "A" frames with twenty points of communication to the vessel and ten to the foundations. The bases of the columns roll on flat plates mounted on grillages which rest on the concrete biological shield.

The pressure vessels were fabricated on the site following trials at the Whessoe works, Darlington. Each involved 1,700ft of welding and all the butt welds were radiographed. Magnetic crack detection was employed to test all fillet welds. The pressure vessels were stress relieved by means of internal radiant type electric heaters. The soaking time was some 7½ hours at approximately 600 deg C.

Construction of Graphite Core

The graphite core of the reactor is cylindrical with a diameter of 36ft and a height of 27ft. It is composed of about 58,300 interlocking and accurately machined graphite blocks and tiles. The interlocking is so arranged as not to disturb the spacing and trueness of the fuel channels, no matter how the graphite itself may move during its life. The assembled core is pierced by about 1,800 vertical channels and six 4oin fuel elements are contained in each of 1,696 channels; the other channels accommodate the control rods and instruments.

A recent design modification introduced in the Chapelcross reactors Nos. 2, 3 and 4, concerns the introduction of removable graphite sleeves into all fuel channels to provide a solution to the stored energy problems associated with irradiation damage of the graphite moderator —the "Wigner effect." In 1942 E. Wigner showed that moderator atoms could be displaced by fast neutrons. These displacements could be permanent, with corre-

sponding changes in thermal and electrical conductivity, electrical constants, thermal expansion, the Hall effect, physical dimensions and heat of combustion. It is the last two properties which largely affect reactor design and operation respectively. Changes in physical dimensions are catered for by permitting adequate growth clearance where necessary.

In the event of graphite with a stored energy content being heated sufficiently above the normal temperature at which irradiation occurs, release of the stored energy will be initiated. Accordingly, a solution has been found in the provision of the removable sleeves, which are so designed that a small gap is left between them and the bulk of the graphite. This gap, which becomes filled with the cooling gas, acts as a thermal insulation barrier and ensures that the bulk graphite temperature is raised above its normal value, thus ensuring some measure of self-annealing.

While this solution has been adopted for reactors Nos. 2, 3 and 4, No. 1 reactor will use an alternative method whereby " Magnox " sleeves will be lowered into unmodified channels, if this should be necessary in the future. This operation, however, reduces reactivity and channel flows and thus reduces power and adds to " outage " times.

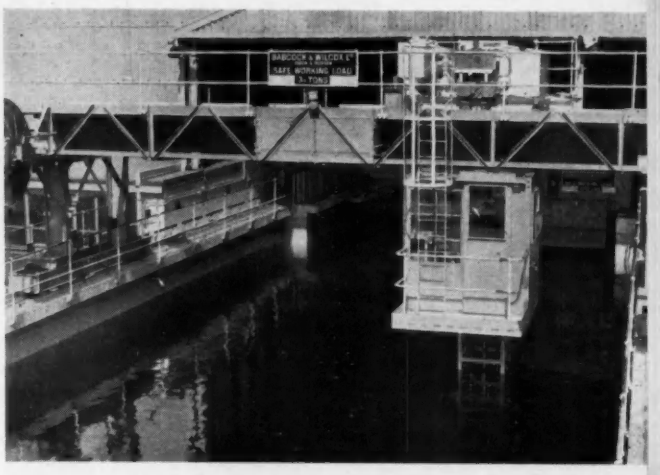
In the roof of the pressure vessel are the tubes through which the fuel elements are loaded and unloaded and the control rods are raised or lowered as required. These tubes pass through the concrete shield roof to the floor above and when not in use are sealed with concrete plugs. To avoid having too many openings in the pressure vessel, each tube is arranged to supply sixteen channels.

The natural uranium bars are 1·15in in diameter and are sealed in magnesium alloy cans with spiral fins to assist in dissipating heat. Each rod is about 40in long and six rods are placed in each channel in the reactor. This fuel is delivered to the station from the U.K.A.E.A. Springfields factory, which was described in the *Electrical Review* of 30th January, 1959.

As the fuel elements are vertical, with blind ends at the bottom, their insertion and removal are carried out through the top of the reactor and, therefore, spent elements have to be removed before they can be replaced by new elements. Two mobile machines for charging and two for discharging are provided for each reactor and they run on a series of parallel rail tracks on the charging floor. A power driven traverser is used to move the machines from one track to another.

Each machine is electrically propelled and carries a winch unit for raising and lowering the elements, one at a time, by means of an electrically operated grab. A wide range of controlled speed is provided from a full speed of 175ft/min and the hoist cable incorporates the necessary electrical cores for operation of the grab and for remote indication. Each machine contains a circular rotating basket for carrying twenty-four elements which are arranged vertically in compartments around the periphery. The basket is rotated one pitch at a time to bring successive elements or empty compartments over the charge tube. New elements are loaded by hand into the baskets in the fuel preparation room, before being lifted into the charge machines, but baskets of spent elements are lowered directly from the discharge machines down a shielded well by a special hoist. In operation, the Strachan & Henshaw charge and discharge machines are practically identical but the latter are much heavier, about 60 tons, since spent elements are radioactive and have therefore to be enclosed in heavy shielding.

At Chapelcross the reactors have to be shut down before charging or discharging can take place, so that the cooling gas pressure is just above atmospheric to prevent air, particularly its argon content, getting into the CO_2. A tube is prepared for charging or discharging by fitting



The spent fuel element storage pond

Fuel storage room. The charge baskets for the charge machine can be seen in the background

No. 1 reactor control room

a valve and gland assembly to it, withdrawing the shield plug and inserting the guide chute which guides the element and grab between the reactor floor and the top of the core, so that one charge tube can serve sixteen channels.

A special well hoist is provided on each reactor for lowering the basket of spent elements out of the discharge machine down through a heavily shielded well to ground level where the basket is deposited in a heavy wheeled cast iron transit vessel containing water. A heavy shielding lid is lowered on to the vessel, which is then transported to the storage pond where the elements will be kept for about 100 days. The water depth in the pond, which is divided into two sections, is about 18ft. Each section holds approximately 400,000 gal of water and has sufficient capacity to hold a number of cartridges equivalent to about three reactor charges. A major function of the pond is to ensure that road transport delays do not increase reactor "outage" times. The pond also assists by keeping the refuelling time to the minimum by providing a storage point in the fuel cycle.

The shielding problems associated with subsequent handling operations are eased by the period during which the elements are stored in the pond. It is estimated that the normal delay period will enable about six times as many cartridges to be transported per container as is possible at Calder Hall.

Reactor Control

The reactor is controlled mainly by the quantity of CO_2 being circulated and secondly by the movement of boron rods into the core. These rods absorb neutrons and control the rate at which fission takes place. The Metropolitan-Vickers control rod system provides "failure to safety" under all conditions. Actuating mechanisms, sixty of which have been supplied for each reactor, combine the functions of control and shut-off as the vertical operation of the rods permits the use of a gravity fall for shut-off. Controlled braking is used so that a high launching speed can be attained with slow touchdown.

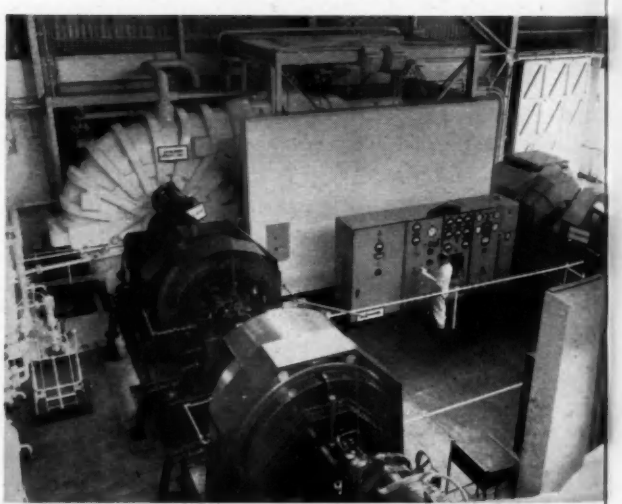
The control rod mechanism consists essentially of an electrically driven winch. The control rod assembly weighs 130 lb with an operational travel of 21ft and is suspended by a special low-cobalt stainless-steel flexible cable, which is edge wound between the side cheeks of a drum. A variable reluctance synchronous driving motor is employed. Speed is varied in the frequency range of 0 to 1·3 c/s with a constant voltage of 40 V. The zero frequency condition is used for holding the rods stationary. The coarse supply is generated by one of two identical frequency-convertor sets consisting of a 37·5 h.p. induction motor, a 22 kVA salient-pole generator and a 19·4 kVA frequency convertor mounted in line on a common bedplate. Fine control is achieved by two sine-potentiometers. The system is designed to move the rods in when the frequency convertor is running sub-synchronously so that, in the event of a failure of drive to the convertor, the system will "fail to safety" by moving the rods in at a maximum speed of 4ft/sec. A Magslip indicator associated with each actuating mechanism shows the position of each rod on a panel in the control room in the reactor building.

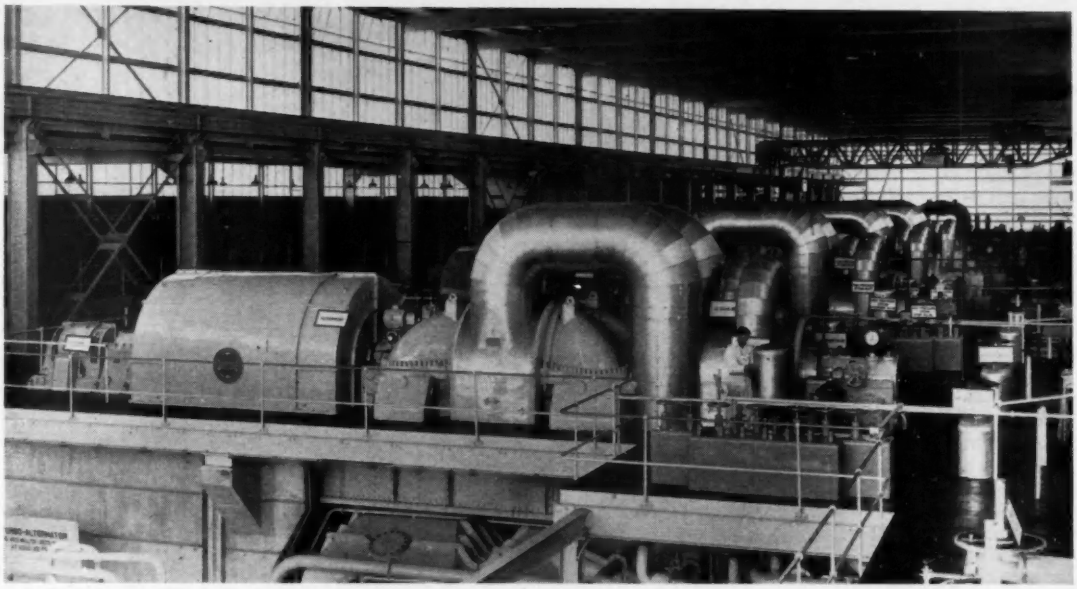
While the reactor is working, various instruments are taking measurements and these are shown on the rows of dials and recorders in the control room. The function of the control engineer is to adjust the gas flow and control rod position to keep the nuclear MW output at a steady value. Alternator loading is carried out in the electrical control room in the administration block. One very important piece of equipment takes samples of gas in turn from the channels and measures the amount of radio-activity in it.

Occasionally one of the fuel element cans develops a slight crack or pinhole and some of the gaseous fission products then begin to escape. As these are radioactive, the particular gas sample from that channel will show a small increase in activity and give warning of the leak. This burst slug detection apparatus involved the provision by Thomas W. Ward, Ltd., of approximately 44 miles of ¼in bore stainless steel tubing laid inside and outside the vessels of each reactor.

The ducts which carry the hot carbon-dioxide gas from the reactor pass through the shield walls and are connected to the tops of the heat exchangers. At the foot of each heat exchanger a duct carries the carbon-dioxide to a large blower which drives it back into the base of the reactor vessel. There are four single-stage centrifugal blowers per reactor (one per heat exchanger)

One of the four gas blowers for No. 1 reactor





Turbine hall showing the 23 MW Parsons machines

driven by a 2,500 h.p. d.c. motor arranged for Ward-Leonard control.

Each Babcock & Wilcox steam-raising pressure vessel unit embodies high- and low-pressure systems, in which approximately 77 per cent of the steam is generated at 210 p.s.i. and 23 per cent at 63 p.s.i. Both systems have superheating, evaporating and economiser sections and each pressure system operates as an independent self-contained unit. Separate steam and water drums are provided; these are of the conventional type containing "cyclone" steam and water separators and scrubbers. All drums, headers and pipework connections are mounted externally on the shell of the steam-raising unit.

The shell of the heat exchanger is approximately 80ft high and 17ft 6in in diameter with a wall thickness of $1\frac{5}{16}$in and weighs, when empty, about 180 tons. Each shell is fabricated from ten sections, consisting of a supporting skirt, two domed heads and seven parallel sections. The shell sections were bent to shape in half-sections and then fusion welded along the longitudinal seams. The domed heads were pressed from petal-shaped steel segments $1\frac{3}{4}$in thick.

Turbine Hall

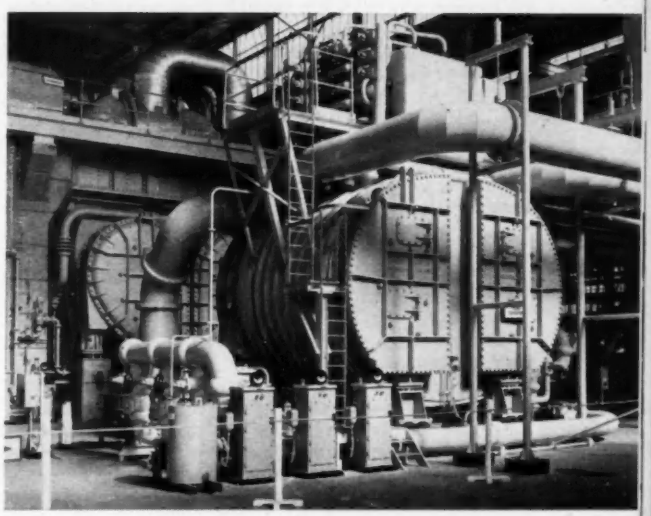
It should be noted that the heat exchanger provides a physical barrier between the nuclear sources of heat and the generating plant. The turbine hall contains eight Parsons turbo-generators, each having a normal rating of 23 MW. Steam is supplied from the heat exchangers at 185 p.s.i. and 590 deg F and low-pressure steam at 38 p.s.i. and 340 deg F, the steam after expansion in the turbine being condensed in the surface condenser at a vacuum of 28·25in Hg. The turbines run at a speed of 3,000 r.p.m. and consist of single-flow h.p. units solidly coupled to double-flow l.p. units. The blading throughout each turbine is of the reaction type. Two steam chests, high pressure and low pressure, are arranged on opposite sides of each turbine and have an emergency stop valve and a governor valve.

As the full heat output from the reactor must be absorbed at all times, the turbines normally operate under steam pressure control, this being the most effective way of controlling the gas temperature circulation between the heat exchangers and reactor. If the reactor heat output exceeds that which can be absorbed by the turbines, the surplus steam is automatically passed to a dump condenser to be returned as feed water to the system.

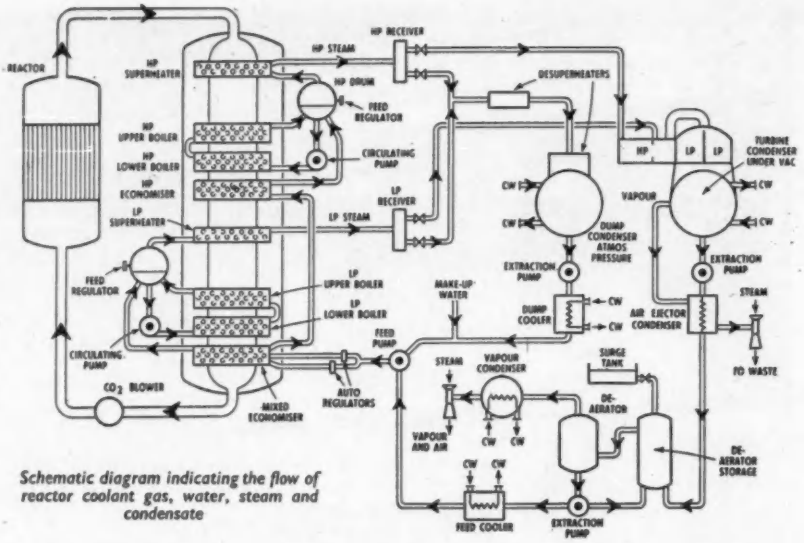
The h.p. and l.p. governor valves, emergency stop valves and steam pressure regulator are operated by power oil supplied by a geared pump mounted on a cross-shaft driven by worm gearing from the steam end of the h.p. turbine shaft. A pump supplying oil to the oil coolers and bearings is mounted on the same cross-shaft.

Each turbine condenser operates at a vacuum of 1·75in Hg and has a total cooling surface of 32,500 sq ft and a

The dump condenser. The secondary desuperheater can be seen on the top of the condenser



cooling water requirement of 25,000 gal/min with a c.w. inlet temperature of 70 deg F and an outlet temperature of 87 deg F. The dump condensers are capable of taking the whole quantity of steam diverted from two loaded turbines. They have a total cooling surface of 12,000 sq ft and a c.w. flow rate of 55,000 gal/min. Primary desuperheaters with mechanically and thermostatically controlled spray nozzles reduce the temperature of the steam entering the dump condenser to about 300 deg F. Secondary desuperheaters are fitted in the top chamber of the condenser, each consisting of twelve nozzles which use condensate tapped from the extraction pump discharge. These reduce the temperature of the steam entering the condenser from 300 deg F to saturation point. There are no air ejectors connected to the dump condensers since they are not required to operate under vacuum.



Schematic diagram indicating the flow of reactor coolant gas, water, steam and condensate

Reference to the diagram will indicate the operation of the feed-water system. It will be noted that the conventional bled steam feed heating system is not employed.

Generators

The generators are of standard design with a continuous maximum rating of 23 MW, 0·8 p.f., 11·5 kV, 50 c/s. They work on a closed air-ventilation circuit, the cooling air being provided by two motor driven fans working in parallel when the machine is fully loaded. The total net electrical output of the station will be 140 MW. Metropolitan-Vickers type VS6 automatic regulators control the output voltage of the generators to within ±1 per cent. These regulators have parallel running compensation to ensure correct division of the station's reactive power between machines.

Each alternator is connected to separate 11 kV, 500 MVA horizontal draw-out switchboards. One of the two generators supplied by each reactor is directly connected to a single circuit-breaker switchboard controlling a 30 MVA, 11/132 kV transformer. The other alternator is connected through a circuit-breaker to a three-unit switchboard; the second circuit-breaker controls a second 30 MVA, 11/132 kV transformer and the third circuit-breaker feeds the reactor auxiliaries via a 30 MVA fault-limiting reactor. The h.v. windings of the two 11/132 kV transformers are connected to the grid and are interconnected through isolators. The reactor auxiliaries can therefore be fed from the other alternator over the 132 kV interconnection.

The 11 kV feeds to Nos. 1 and 2 reactors are interconnected by the 350 MVA switchgear in the reactor building. The same conditions apply to Nos. 3 and 4 reactor supplies. The gas blowers are supplied at 11 kV and the other reactor auxiliaries operate at 415 V. In the turbine hall both 3·3 kV and 415 V are used.

Further justification of the Authority's confidence in the general Calder Hall design is the fact that five civil stations of this type (including the Italian station) are now under construction, the basic difference being the use of thicker pressure vessels at the new stations. As Calder Hall and Chapelcross are principally designed to produce plutonium, there will be a more complete combustion of the nuclear fuel at the new civil stations, giving about double the power output for equal quantities of fuel.

The Chapelcross works was designed by the Industrial Group of the United Kingdom Atomic Energy Authority. The consulting engineers for the power plant layout, services and civil engineering are Messrs. Merz & McLellan, who are also construction agents for the whole project. The architects for the administration buildings, canteen and housing schemes are Messrs. L. J. Couves & Partners.

The main contractors are:—W. H. Allen, Sons & Co., Ltd., Babcock & Wilcox, Ltd., Sir W. H. Bailey & Co., Ltd., J. Blakeborough & Sons, Ltd., Wm. Boby & Co., Ltd., John Boyd & Co. (Engineers), Ltd., Broadbent & Co. (Rochdale), Ltd., Bruce Peebles & Co., Ltd., Cochran & Co. (Annan), Ltd., Crossley Bros., Ltd., Distillers Co., Ltd., Elliott Bros. (London), Ltd., English Electric Co., Ltd., Alex. Findlay & Co., Ltd., Matthew Hall & Co., Ltd., W. T. Henley's Telegraph Works Co., Ltd., Hopkinsons, Ltd., James Howden & Co., Ltd., George Kent, Ltd., James Kilpatrick & Son, Ltd., Metropolitan-Vickers Electrical Co., Ltd., Mitchell Construction Co., Ltd., Newalls Insulation Co., Ltd., C. A. Parsons & Co., Ltd., Permutit Co., Ltd., Plessey Nucleonics, Ltd., A. Reyrolle & Co., Ltd., James Scott & Co. (Elecl. Engineers), Ltd., Stewarts & Lloyds, Ltd., Strachan & Henshaw, Ltd., A. A. Stuart & Sons, Ltd., Sulzer Bros. (London), Ltd., Taylor Woodrow Construction, Ltd., Versil, Ltd., Thos. W. Ward, Ltd., Wallace & Tiernan, J. M. Wells & Co., Ltd., Wharton Crane & Hoist Co., Ltd., and Whessoe, Ltd.

Electronic Valve Standard

THE British Standards Institution announces the publication of Section B5B/F of B.S. 448, "Electronic Valve Bases, Caps and Holders." The nine-page document, which specifies the dimensions of the B5B/F valve base and outline, replaces Section B5B of B.S. 448 : 1953. Copies may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 2s.

Thermonuclear Processes

EXPERIMENTAL WORK REVIEWED AT I.E.E. CONVENTION

In conjunction with the British Nuclear Energy Conference the Institution of Electrical Engineers arranged a convention on thermonuclear processes which was held at the Institution of Civil Engineers in London last week. The main point brought out was that it was necessary to reach a satisfactory agreement between theory and experiment for only then should we begin to know what was needed for a successful thermonuclear power producing device

By C. P. HAIGH, B.Sc., Ph.D., F.Inst.P.

POWER production based on the fission of heavy nuclei, particularly of uranium, is now firmly established. The inverse process, fusion of light nuclei such as the isotopes of hydrogen, is also exoergic and offers the prospect of a source of power, possibly extracted directly as electricity, derived from an effectively inexhaustible supply of fuel. To obtain an overall energy gain the ordinary methods of nuclear bombardment, long employed to demonstrate fusion reactions in the laboratory, are inadequate. A controlled thermonuclear reaction is necessary. Such processes have been the subject of much secret investigation during the past several years, but about the time of the 1958 Geneva Conference restrictions ended and there are now no restrictions on discussion.

In this atmosphere the first Convention on Thermonuclear Processes to be held in Great Britain was arranged by the Institution of Electrical Engineers (in conjunction with the British Nuclear Energy Conference) and held in London at the Institution of Civil Engineers on 29th and 30th April. The Convention was well attended and there were delegates from a number of overseas countries, including both Russia and America.

In his opening remarks to the Convention, Dr. B. F. J. Schonland, director of the Atomic Energy Research Establishment, Harwell, emphasised that despite brilliant theoretical, experimental and engineering work, nobody in the world had yet succeeded with certainty in the very first stage of producing a true controlled thermonuclear reaction. The essential problem of confining a completely ionised gas, or plasma, for a time long enough to raise it to the required temperature had turned out to be exceedingly difficult.

During the course of the Convention it also became clear that apart from establishing the physical facts of plasma behaviour at both high temperature and high conductivity a large amount of supporting research and development was involved. The experiments require energy storage arrangements of a novel kind; developments in the techniques of high vacua and of rapid, high current switching; careful examination of structural materials; and electronic and diagnostic devices previously unknown. The solution of these problems will undoubtedly have application in many other branches of science and engineering.

The basic physics of thermonuclear processes was presented in a paper by Dr. T. E. Allibone and Mr. D. R. Chick, both of the A.E.I. Research Laboratory. Nuclear reactions which appear promising for a controlled fusion reactor are those involving the various isotopes of hydrogen, helium and lithium: to date most of the experimental work has been done with the heavy hydrogen isotope, deuterium. Collisions between such nuclei are much more likely to result in scattering than in fusion and so to achieve a significant number of fusion reactions conditions must be such that each nucleus undergoes many collisions before leaving the system.

A high-temperature, fully-ionised plasma of deuterons and electrons is a possible fuel in which case the release of fusion energy requires an initial temperature of 10^8 to 10^9 deg K and the process must continue long enough for each ion to suffer several hundred collisions due to its energetic thermal motion. Furthermore, a thermonuclear reactor can be successful only if there is an excess of energy yield over loss. This implies complete containment of the hot reacting plasma so that no charged particles reach the walls of the enclosing vessel and the only energy loss is by radiation.

In the absence of restraining forces an impossibly large vessel would be needed and the alternative is to modify the behaviour of the plasma by electric and magnetic fields. The various ways of doing this divide present fusion devices into two broad categories: (i) Those in which the plasma is confined by magnetic fields resulting mainly from the plasma current, e.g. the stabilised toroidal pinch; and (ii) those in which the confining fields are provided by external currents flowing in metallic conductors, e.g. mirror machines. Type (i) devices are essentially pulsed in operation whilst type (ii) may eventually be made quasi-continuous.

Different Approaches

The Convention reviewed the major experimental programmes now in progress throughout the world. The United Kingdom has concentrated on pinched discharge devices as exemplified by Zeta (Harwell) and Sceptre (A.E.I.), but elsewhere there is great activity with devices relying on external magnetic fields to produce confinement. In particular, very extensive and diverse researches are being conducted in America where examples of all types of devices are at present under consideration.

Two sessions were devoted almost entirely to the design, performance and constructional features of Zeta. This apparatus was designed to produce a hot plasma for experimental studies of the possibility of a thermonuclear reactor based on the pinched gas discharge. The basic circuit is a capacitor discharging through a mechanical switch into the primary of an iron-cored transformer. The secondary is deuterium gas at a working pressure of 10^{-4} to 10^{-3} mm mercury contained in an aluminium torus of 1 metre bore and 12 metres mean circumference. Discharging 1,600 μF at 25 kV

through the primary induces up to 2×10^5 A in the gas with a pulse duration of about 5 millisec. This current produces a gas temperature of roughly 10^6 deg K and creates a magnetic field that isolates the plasma from the torus walls.

Such a pinched current channel is, however, inherently unstable. It is controlled in Zeta by a magnetic field, parallel to the centre line of the discharge tube, produced by a toroidal coil wound on the torus and also by eddy currents induced in the metal torus walls. The insulation of the torus lining was a limiting factor in the experiments and so, in 1958, Zeta was modified and provided with a stainless steel bellows lining. At the same time the mechanical switch was replaced by an ignition and the vacuum pumping, stabilising field and diagnostic facilities were improved.

In general, most experimenters with pinched discharge devices have observed neutron production. Neutrons are expected from fusion reactions such as $D+D\rightarrow He^3+n$, but nobody has yet been able to claim that the observed neutrons have arisen from fusion. Another observation on both fast and slow pinch systems is that a large unaccountable energy loss always occurs. Some experiments with Sceptre IIIA, reported by Dr. A. A. Ware, suggest that a large electron energy loss is caused by an electron-particle loss to the tube walls.

Magnetic Mirror Machines

An account of some Russian work on magnetic mirror machines was contributed by I. N. Golovin. In these devices ions are injected and trapped between magnetic fields and thereafter undergo a large number of reflections between these magnetic mirrors. Golovin stated that it might be possible to release about 10^5 kW of power per cubic metre of a deuterium-tritium plasma at 10^9 deg K using a field of 50,000 oersteds in a 2 metre diameter mirror machine. Some major problems are involved such as whether the developed theory of motion of an individual particle applies to a large number of reflections from magnetic mirrors and whether dense hot plasma will be stable in magnetic fields of this type.

The first problem was studied by Rodionov who examined the motion of tritium decay electrons in a small magnetic mirror machine and showed that under certain conditions the particles could undergo 10^7 reflections before loss. This is practically sufficient for any thermonuclear device and, in addition, work by Chirikov has shown that it is not difficult to produce the necessary symmetry of the magnetic fields required in experimental or industrial plants.

Information on hot plasma stability in magnetic fields has not yet been obtained: the Ogra installation was set up in 1958 for this purpose by the U.S.S.R. Academy of Sciences. Ogra is designed to accumulate hydrogen plasma to a density of over 10^{12} ions/cm^3 between magnetic mirrors separated by 1 to 12 metres. This very large machine has a stainless steel vacuum chamber 19 metres long by 1·4 metres in diameter in which the pressure can be reduced to 3×10^{-8} mm mercury before the injection of hydrogen ions. When Ogra is complete it is intended to undertake a systematic study of plasma stability for densities greater than 10^8 ion/cm^3 and it is hoped that this will lead to the development of the mirror machine as a power producing plant.

In contrast to the single method approach adopted by most countries, the American programme is almost overwhelming in its variety. Lecturing on thermonuclear research in the United States, Dr. C. M. Van Atta dealt with six different systems, each of which is the subject of several experimental installations. There are a number of pinched discharge devices such as the Perhapsatron S4, a small toroidal apparatus, and the linear pinch Columbus apparatus, but in the main the American effort is concentrated on methods employing external confining fields. Of these the Stellarator, a name given to the system being developed by Spitzer at Princeton, attempts plasma confinement by a magnetic surface generated by displacing an external magnetic field through an angle θ instead of closing it on itself after one revolution.

One means of achieving this transformation is to twist a torus into a figure eight. Another is to use a transverse magnetic field whose direction rotates with distance along the magnetic axis and this may be achieved by suitable helical coils wound on a simple torus. A large Stellarator installation costing about £10 million is now nearing completion. The success of the system appears to depend on the development of a suitable method of plasma heating for Joule heating is insufficient. A "magnetic pumping" method in which the plasma is alternately compressed and expanded by an r.f. field is under investigation.

The Astron is another device using the principles of closed magnetic lines. Magnetic mirror machines are also being examined. The D.C.X. machine at Oak Ridge is much shorter and more compact than the Russian Ogra and with it the containment of single particles for 10 millisec has been achieved. Scylla is another mirror system with which neutrons have been observed but no claim has been made that thermonuclear reactions have occurred. America also has some devices such as the Homopolar machine (Berkeley) and the Ixion (Los Alamos) in which the loss of particles is prevented by causing the plasma to rotate. In both cases this is achieved by applying strong radial electric fields.

As might be expected, the interest in external field devices has stimulated a large effort on ion injection methods and another promising development is the cooling of field coils to obtain very strong magnetic fields without excessive I^2R losses. American opinion seems to be that power production by thermonuclear means will be achieved by other than pinched discharge devices.

Torus Construction

Some associated technological problems, with particular reference to Zeta, formed the subject of a number of papers. Dr. Robson and Dr. Hancox dealt with the choice of materials for heavy current toroidal discharge tubes and concluded that metals possess marked superiority over insulators but suffer from unipolar arc formation which has proved a serious source of plasma contamination in existing metal toruses. Materials of low atomic number reduce thermal evaporation and sputtering of the wall. The most promising solution at present seems to be a two-gap metal torus containing a segmented liner system.

Other papers concerned the design of vacuum systems, switching problems and physical measurements on heavy current discharges. Looking forward to engineering design problems associated with new systems, the Convention was informed about low-inductance switching using parallel spark gaps and of the ignitron as a switch in heavy current pulsing circuits. Another paper was devoted to transformer design for toroidal discharge systems and Tosswill and Hope demonstrated that if a torus with a continuous conducting liner is used, then the energy loss in the liner can usually be tolerated.

The final session concerned the constricted plasma and its future. R. J. Bickerton reviewed the state of research into the toroidal pinch, summarised the theory of the stability and heating of such discharges and listed fourteen

main problems awaiting solution. Dr. Niblett, reporting some A.W.R.E. work, suggested that a plasma can be heated and confined by a rapidly rising axial field produced by azimuthal currents and a mathematical paper on the circuit dynamics of plasma was presented by B. S. Liley.

Perhaps the most interesting paper in this session, however, was given by J. D. Jukes and concerned possibilities of direct energy conversion from fusion reactors. For a reactor working on the stabilised-pinch principle it was suggested that the plasma might be alternately compressed and expanded by modulating the pinch current and that a plasma containing a source of nuclear thermal energy when treated in this way would do work on the confining magnetic field. This is analogous to the gas in an internal combustion engine working against the piston. Both sinusoidal and square wave modulation were considered, with the conclusion that only the latter could yield a significant conversion efficiency. The work done on the confining field by the plasma would appear directly as energy in the external circuit and the power could be drained off in a number of ways; for example, in a resistive load coupled inductively into the circuit.

It was predicted that about one-third of the energy might be extracted directly, but that in a power reactor this would require modulated currents of 10^7 A with periods of about 0·1 sec. It does not seem likely that all the fusion energy can be extracted directly, however, since 20-30 per cent of it appears in the fusion neutrons and, presumably, can be extracted only by means of a thermal cycle. Moreover, the suggestion presupposes idealised conditions in the toroidal pinch but it does show that successful direct conversion might save about one-third of the heat-exchanger-turbine capacity required for an indirectly-converting reactor. This is an important economic saving, even in a system that might operate with a negligible fuel cost.

Sir George Thomson, in a closing contribution, fairly summarised the lessons of the Convention. There was no doubt, he said, that theory and experiment were in better agreement for magnetic mirror devices than for stabilised pinch systems. For the latter there was no proof that the theories were wrong but there was little evidence that they were right. The whole problem now needed to be studied in a collective fashion especially as large-scale apparatus was undoubtedly involved. A few things were already clear: the purity of materials was important since the presence of heavy ions in the plasma was a serious disadvantage and magnetic fields free from irregularities were essential. The central problem, however, was to reach a satisfactory agreement between theory and experiment for only then should we begin to know what was needed for a successful thermonuclear power producing device.

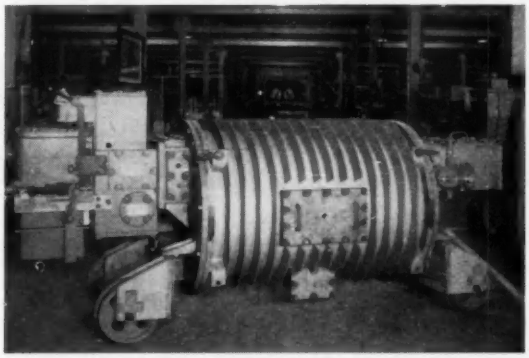
Mobile Mining Substation

THE silver plaque for the most outstanding item of industrial equipment shown at the recent A.S.E.E. exhibition (see *Electrical Review*, 27th March) was awarded to the 300 kVA, three-phase, 3,300/565 V mobile mining transformer substation manufactured by the Brush Electrical Engineering Co., Ltd., a member of Hawker Siddeley Industries.

Class C insulation has been used, enabling the air-cooled transformer to operate at high internal temperatures, although the maximum case temperature is below that of conventional oil-filled transformers. When operated at the maximum continuous rating in an ambient temperature not exceeding 25 deg C, the transformer requires 36 hours to attain steady temperature conditions, and under the cyclic-loading conditions encountered in shift work overloads as high as 150 per cent of full load can be sustained for considerable periods.

The interleaved transformer core is constructed of insulated cold reduced grain-oriented steel laminations, the legs are bound with glass tape and the yokes rigidly supported by steel clamps bolted in position. Both high- and low-voltage coils, wound in square form, are of rectangular conductors of high conductivity, soft drawn, asbestos wrapped copper. The cylindrical transformer casing is made from structural steel plate with continuously welded internal and external cooling fins and end flanges contributing to a rigid structure which can withstand normal falls of rock commonly experienced near the coal face. The h.v. and l.v. terminal arrangements and transporting wheels are bolted on the sides of the casing, the mounting being adjustable so that the four flanged wheels can run on any track between 18 and 36in gauge.

The transformer is claimed to be the first wholly British flameproof dry type unit produced and granted an approval certificate for use in methane-affected areas by the Safety in Mines Research Establishment at Buxton.



Brush 300 kVA mining transformer

Transmission Cable Ratings

A recent E.R.A. report, Ref. F/T187 (price 27s), by H. Goldenberg, deals with the calculation of continuous current ratings and rating factors for transmission distribution cables. An earlier report, Ref. F/T183, presented current ratings and rating factors for paper-insulated cables to B.S. 480:1954, and varnished-cambric-insulated cables to B.S. 608:1955. The figures in that report were calculated largely on the basis of formulæ given in report Ref. F/T131. New methods of procedure and graphs to facilitate calculation have since been derived, however, and sections (2) to (7) of the present report combine the detailed method of current rating calculation of Ref. F/T131 with the modifications used in the calculation for figures presented in Ref. F/T183. In addition, the final section of the present report is devoted to the methods of current rating calculation for various forms of high voltage cables other than solid types.

Electrical Films at Harrogate

By ALEC M. HUGHES

"CONQUEST of the Atom," made by the Realist Film Unit for Mullard and the Educational Foundation for Visual Aids, was awarded a plaque as the best film concerned with "Education and Training Outside Industry"—one of the nine competitive categories at the recent Harrogate Festival of Films in the Service of Industry. One hundred and twelve British films (chosen from 260 entries) competed for awards, and an honourable mention was accorded "Power in Plenty" made by C.A.S. Productions for B.I. Callender's Cables.

These two award winners gave some idea of the variety of films concerned with aspects of electricity which were screened during a busy week of viewing. "Conquest of the Atom" tells the story of nuclear research from Thomson and Rutherford to Cockcroft and Chadwick. It was fitting that at this Festival Sir John Cockcroft himself should have paid tribute to the contribution that film can make to the spread of scientific knowledge. At a time when the rate of technical progress impressed the mind of the scientist let alone that of the layman, said Sir John, the legend still persisted that scientists "were long-haired gentlemen without any human desires or weaknesses engaged in a modern version of witchcraft." There was no excuse for perpetuating this legend of supermen when so many scientists perforce appeared on television these days. Of necessity, also, the scientist had to explain his work to colleagues in other fields, to politicians, and to the man in the street.

Popularising Science

Talking of recent visits abroad Sir John said that he had been greatly impressed by the efforts made in the Soviet Union to popularise science, and he had found both there, in Persia, and elsewhere, that films had helped him to present scientific knowledge. "When I travel about the world I usually take one or two films with me. We could with profit produce many more scientific and documentary films and help to break down the serious barriers between the scientist and the man in the street."

"Radioisotopes in Industry," made by G. Buckland Smith for the Atomic Energy Authority, was a film which did this admirably. Explaining in simple terms the nature of radioisotopes, it gave many examples of their practical application—not only in medicine, but for such diverse tasks as tracing the flow of silt in the Thames and checking on the accurate mixing of different types of sand for use in a glassworks.

The sort of contribution that television can make to informing the layman was to be seen in "Colin Wills Reports on Electricity Supply"—a film made for television by World Wide Pictures for the Central Electricity Generating Board. It gave an interesting account of the complex organisation which generates electricity for the national grid, with compelling examples of the unexpected problems which have to be dealt with, such as a cloudburst in one city, necessitating the feeding of surplus electricity into the area from other regions. It emphasised that electrical output had doubled in the last ten years and must increase by the same amount in the next decade to keep pace with rising demand.

"The Future is Electric" gave some useful examples of the way in which electricity can contribute to the effective implementation of the Clean Air Act, 1956. But is it very good public relations on the part of the British Electrical Development Association to sponsor a film which not only lays the blame for most of the air pollution at the door of coal burning and railway transport without suggesting ways in which these two largest employers of labour can contribute (and are contributing) to better atmospheric conditions, but also fails to mention that the electricity supply industry is itself a big consumer of coal?

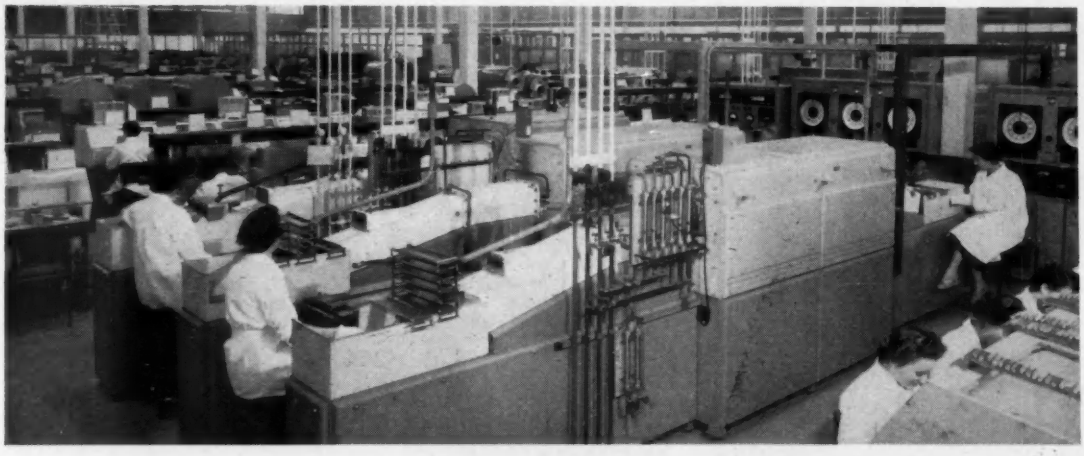
One glimpsed something of the railways' positive approach to this problem not only in the British Transport films "Groundwork for Progress" (about railway modernisation) and "Rail Stress" (about research), but also in "On the Track of Efficiency," made by C.A.S. Productions for B.I. Callender's Cables, which gave a detailed account of the erection of a 25 kV 50 c/s overhead system for railway electrification. Another aspect of transmission line erection was seen in the delightful colour film by Edison Volta S.p.A. "Tre Fili Fino a Milano," illustrating some of the difficulties encountered by a team of workers building a high-voltage line across mountainous country.

But there are more homely aspects of electricity which are often the only conscious link between the industry and the man in the street. "The Electric Iron," made by Merton Park Productions for E.D.A., was a model of a simple teaching film—outlining the history of the flat iron and explaining the principles and operation of thermostatically controlled dry and steam irons. "Creda Corvette" extolled the virtues of the Simplex Electrical Co.'s compact portable electric water heater of entirely new design. The G.P.O. (pioneer sponsors of documentary film) showed they had lost none of the knack of expounding new ideas to the public in their simple explanation of the new trunk dialling system now gradually being introduced. "The Twopenny Telephone" indeed was an admirable example of the value of film for bringing knowledge of technical change to the layman.

Factory Accidents

THE April issue of the H.M. Factory Inspectorate publication "Accidents" (H.M. Stationery Office, price 1s 3d) includes, as usual, a section dealing with electrical accidents. One accident involved a 110 V test lamp. A temporary electrician placed the lamp connections across what he thought to be a 100 V secondary winding of a welding transformer. He was, however, unwittingly testing across the 440 V primary winding. The test lamp exploded violently and glass splinters entered his right eye and necessitated its removal.

Another accident resulted from a hazardous method of replacing lamps in overhead lighting fittings in a large engineering shop. The apprentice electrician concerned was working from a plank supported on two adjacent roof trusses. To reach one lamp he stepped off the plank on to the main ties of one of the trusses and used the electrical conduit as a hand-hold. In attempting to remove the lamp, the glass bulb parted from the metal base and, in trying to withdraw the metal base from the socket, he received a shock from the exposed filaments of the lamp. This caused him to release his hold and fall 16ft to the ground.



Semiconductor Factory Expansion

THE second stage of the Mullard semiconductor factory at Southampton has now been completed and is already being used for production, adding approximately 50,000 sq ft of floor area to the plant's manufacturing capacity. A large new canteen has also been built. A description of the first section of this factory and some of the manufacturing processes carried out was published in the issue of *Electrical Review* dated 24th May, 1957. Large-scale manufacture of h.f. transistors has been carried out during the last two years and within the next year or so transistors operating at 50 to 100 Mc/s will become available in quantity. Much of the space in the new section is given over to the production of silicon transistors and diodes, for which there is a rapidly growing demand for use in both industrial and military equipments. At present the percentage of silicon devices manufactured is comparatively small, but it is expected that by 1960 they will account for a significant proportion of the company's planned total output of 20 million units.

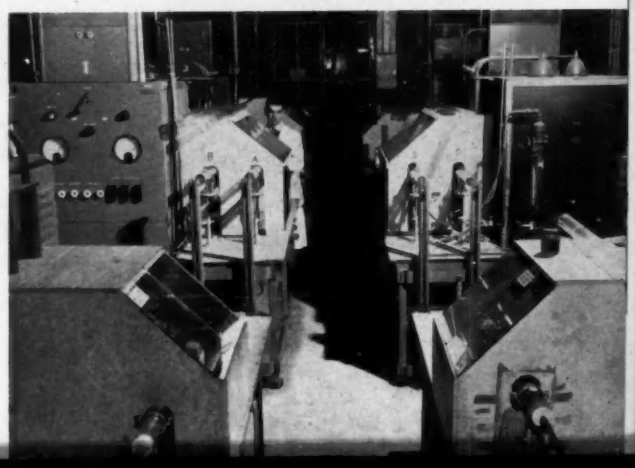
The extra manufacturing capacity resulting from the completion of the new section, combined with the increases in productivity achieved by advances in technology and manufacturing techniques during the past two years, will enable the factory's output in 1959 to be more than twice that of the previous year, representing in monetary value two-thirds of the company's total semiconductor output, the remaining third being supplied by the Mitcham plant and other factories in the organisation.

The next stage in the development of the Southampton plant is to be the construction of an administration block having a floor area of 30,000 sq ft and housing general offices and laboratories, scheduled for completion early in 1960. This will enable a further area of factory floor space now being used for offices to be devoted to manufacturing processes and will also give space for a new applications group. Following this, a further large section is to be added to the main factory building. There are at present over 1,000 employees in the factory, of whom 70 are graduate scientists and engineers working in the laboratories, and when the factory is completed some 2,000 to 2,500 will be employed.

Above : In the alloying process for germanium audio frequency transistors the n-type germanium for the base of the transistor and the indium pellets for the emitter and collector are loaded into carbon jigs which travel through the furnaces on moving belts

The manufacturing policy of the company, which ensures that no transistors are put into production until they can be produced at economic market prices and in sufficient quantities to fulfil the expected demand, has enabled prices to be steadily reduced during the past year and it is expected that a further major price reduction will be announced shortly.

Above: Part of the assembly bay for silicon alloy junction transistors. Below: General view of the germanium zone-refining and levelling sections. Zone-refining purifies the germanium to one part in 100 million, and in the levelling process the bar of pure germanium is converted to a single crystal and the required amount of wanted impurity added



LIGHTING RESEARCH AND DEVELOPMENT

New Premises at Leicester

The A.E.I. Lamp & Lighting Co.'s new headquarters building at Leicester

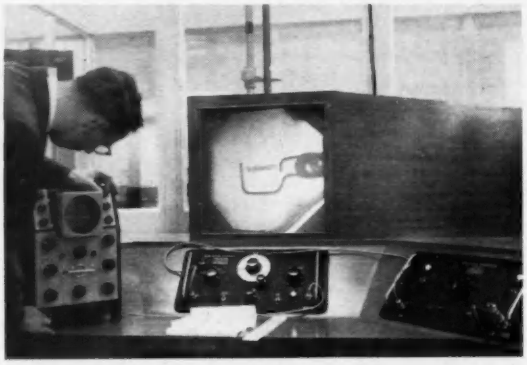
INTEGRATION of the activities of the four lamp-making concerns embodied in the Associated Electrical Industries group, under the title of the A.E.I. Lamp & Lighting Co., Ltd., was taken a step further when a new headquarters building at the Leicester works of the company was put into commission last week. The premises house administrative offices and research, development, and pre-production laboratories.

In the construction, provision of services and decoration of the new building there was close co-operation between the company's architects and the staff. The building, which gives 60,000 sq ft of office accommodation and 40,000 sq ft of north light bay area, has 12ft bays in each of which two lines of " Invertrunking " are run for lighting and other smaller electrical applications. As is fitting in such premises, particular regard has been paid to the lighting. Various methods have been employed in different departments, including in some sections a special arrangement of lighting to fit in with the hot water coils of a heating system in an " acoustic " ceiling.

Last Friday representatives of the Press were welcomed in the new building by Mr. S. R. Eade, managing director of the A.E.I. Lamp & Lighting Co., Ltd., and shown some of the equipment and examples of work currently being carried out. The outstanding development is a new linear sodium lamp which produces over 100 lumens per watt—an improvement of 20-25 per cent over the performance hitherto obtained from sodium. At the high temperature reached in vaporising the sodium metal, hot spots develop and, in a circular tube, spread, causing migration of the vapour and considerably diminishing the light output. In the new design this is overcome by forming " crescents " at intervals in the tube; these form cool areas which " capture " the vapour. Although something similar has been done with fluorescent lamps

General view of discharge lamp development area

Above: A corner of the discharge lamp development laboratory showing, on the right, the new high efficiency sodium lamps. Right: Three-phase h.p. lamp designed to avoid mains frequency ripple



The magnified image of a lamp filament assembly can be studied on this screen, using stroboscopic illumination. A wave analyser is used to study complex vibration wave forms and divide them into component accelerations

in the United States it is claimed that this is the first application of the principle to the sodium lamp. The new form has been produced in 100, 150, 200 and 250 W sizes.

Samples were seen of sodium lamp tubes showing the discolouring effect of the action of the vapour and the solution of the problem—an ordinary glass tube provided with an inner lining of sodium-resisting glass which remains undiscoloured.

A three-phase h.p. lamp now in development is designed to avoid mains frequency ripple. The 3 kW lamp seen has an efficiency of about 60 l/W. Samples were examined of 9in 6 W fluorescent lamps of a type being employed in cabin fittings in three Royal Mail liners now being built. With Wood's glass envelopes this kind of lamp is in use for illuminating the luminescent dials of aircraft instruments. Double coating of fluorescent tubes to improve the colour rendering of red and yellow materials is another recent departure.

A method of maintaining the efficiency of fluorescent lamps with increased wattage is to fit a long stem at the tube end, thus providing a cold region in which the mercury condenses, to maintain the required vapour pressure. Also seen in the Discharge Lamp Laboratory was a transistorised invertor which transforms a 24 V battery supply to a.c. at 1,250 c/s to feed 40 W fluorescent tubes for bus and train lighting.

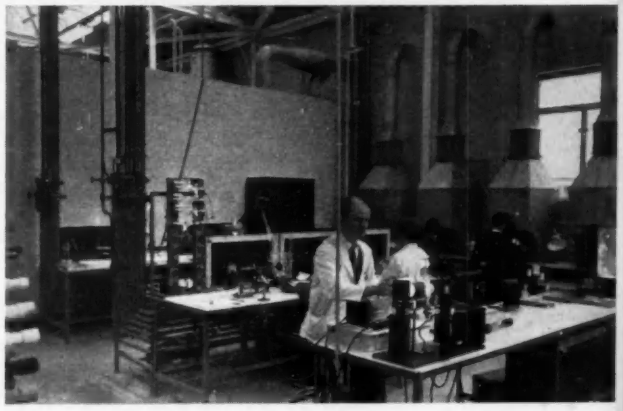
One of the exhibits in the Application Development Department was a 2 kW xenon lighthouse lamp for operation from a 28 V battery. A pulse from a 5 A micro-switch is stepped up for starting the lamp and the xenon arc is extinguished by an electromagnetic blow-out. In the same department a demonstration of electroluminescence was given—the excitation of a phosphor by the application of an alternating current. So far the device is applicable only to glowing indicators. Somewhat similar in character are lamps containing a gaseous radioisotope (tritium) which activates a phosphor coating and produces a dim light (0·0045 lumen).

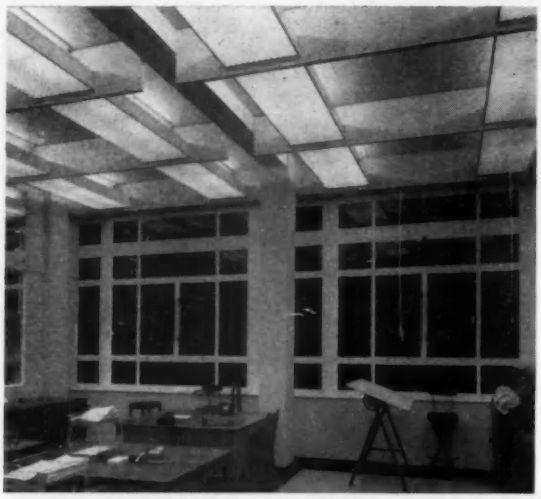
Among other equipment examined were polar co-ordinate photometers; a spherical integrator and optical bench for measuring the performance of experimental light sources; and a Donaldson 6 primary colorimeter for measuring colour rendering from six wavebands.

Filament Lamps

Apart from the work being done on discharge lamps, development also proceeds on general lighting service (g.l.s.) types and in the laboratory devoted to this purpose we were shown apparatus for testing the resistance of a filament to shock while in service. Repeatedly applied taps by a small hammer on the bulb of a horizontally-mounted lamp cause a gradual increase in current and eventually failure. The apparatus is employed to gauge the effect of modifications of the filaments and their supports upon lamp life. Other tests were in progress to determine the effects of variations in filament material

Glass and quartz fabrication section of the lamp development area. In the foreground a 2 kW xenon lamp is being checked for correct arc length. An image of the electrodes is cast on the screen at the far end of the bench





Left: Ceiling incorporating heating, lighting and sound control used in some of the offices. Above: In the boardroom direct light is from a special framework above the table and wall lighting is by louvred peripheral lighting

and coil design upon the efficiency of lamps in various positions.

In addition to examples of the compact " Netabulb " lamps, introduced fairly recently, there was a range of new 40 W small decoration lamps for use in " contemporary " fittings. The bulbs have a coating of white titanium oxide which is chemically inert and non-fading. Another innovation is a set of internally-coloured lamps of much improved appearance and not having the shortcomings of externally-coated lamps. Transparent coloured glazes with superior qualities are being developed for use on spotlight reflectors. A new reflector lamp has an Edison screw moulded neck on to which the cap is screwed and fixed by high-temperature resisting silicone resin. This enables the lamp to be used in ambient temperatures in which normal capping cement would disintegrate.

Among other work being carried out in the department are experiments on various high-resistivity glasses to secure a glass which will ensure that there is no electrical leakage between the electrodes and filament supports in high-voltage lamps. Also seen in this department were hard glass red-stained reflector infra-red lamps, black glass infra-red lamps and 500 W photofloods, photospots and floodlights.

Photometric, life performance and behaviour tests were seen in progress and a number of special types of lamp were examined. The planning of the floodlighting of large areas has been greatly simplified by the use of a spherical chart on which the installation can be designed on the basis of intensity or candle power required, rather than on illumination. A digital computer is employed to check the scheme by point-to-point calculations of illumination on any required planes. Data is thus obtained by which the setting of the floodlights can be done in daylight, using artillery aiming equipment. By these means a large installation has been carried out at the Crewe railway yards without the need for trial and error adjustments at night.

Throughout the tour we found every indication that the art and science of illumination is a very live one and many promising ideas are in process of realisation.

NEW BOOKS

Railways into Roadways? — Are Railways Doomed? Pp. 97. Morgan Bros. (Publishers), Ltd., 28, Essex Street, London, W.C.2. Price 6s 6d.

This book consists of reprints from the *Engineer* of leading articles and correspondence following upon the presentation of a paper on the conversion of railway tracks into roadways by Brig. T. I. Lloyd before the Institution of Civil Engineers. Every aspect of the subject seems to have been covered. Although there seems to have been a slight majority in favour of conversion there are some telling arguments against the proposal, including contributions from Messrs. C. J. O. Garrard and R. D. Reynolds, members of the electrical industry.—J.H.C.

New Developments in Industrial Control. Introduction by John Ryan; edited by Martin D. Callender. Pp. 58. Department of Management Studies, The Polytechnic, Regent Street, London, W.1. Price 5s.

This book surveys five approaches to industrial control —economic forecasting, management accounting, electronic computer, statistical and personal—each of which is contributed by a specialist in his subject.

Welding Handbook. 4th Edition. Part II—Welding Processes: Gas, Arc and Resistance. By the American Welding Society. Pp. 632; figs. Cleaver-Hume Press, Ltd., 31, Wright's Lane, London, W.8. Price 72s.

Produktenboek. 2nd Edition. Pp. 340. Association of Metalworking Industries, Nassaulaan 13, The Hague, Holland. Copies obtainable free of charge from the Association.

Practical Metrology. By K. J. Hume and G. H. Sharp. Pp. 86; figs. MacDonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 10s 6d.

Modern Electronic Components. By G. W. A. Dummer. Pp. 472; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 55s.

Patents for Engineers. By L. H. A. Carr and J. C. Wood. Pp. 107. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 18s.

British Instruments—Directory and Buyers' Guide. Pp. 322; figs. United Science Press, Ltd., Boswell House, 9, Gough Square, Fleet Street, London, E.C.4. Price 42s.

CO-OPERATIVE ELECTRICAL RESEARCH

Improvement in the Financial Position of the E.R.A.

THE 38th annual report of the British Electrical and Allied Industries Research Association (E.R.A.) covering the year 1958 has been published this week. In the previous year's report concern was expressed regarding the financial position of the Association and it was pointed out that a substantial increase in income would be necessary if it was to continue to fulfil its functions efficiently and satisfactorily. According to the current report the increase in subscription income has been substantially obtained by an increase in the basic rate. The total income of the Association in 1958 was £458,070 as compared with £417,654 in the previous year.

Sponsored researches again show an increase—the figure now standing at nearly £113,000—and there was a gross income of £19,960 from E.R.A. patents largely due to accumulated licence fees from Germany on switchgear patents. There was a deficit on the income and expenditure account of £3,732, but the balance carried forward to the balance sheet was £62,695 as compared with £47,943 at the end of 1957. The Council feels that the financial position is satisfactory but that there is no justification for complacency because the grant-earning income must attain £302,000 in 1961, the last year of the quinquennial agreement with the Department of Scientific and Industrial Research.

Dielectric Investigations

The work of the E.R.A., which the report describes, covers a very wide field and researches which appeal to one will not necessarily interest another. There is one sphere of work, however, which is of direct benefit to every organisation connected with the electrical industry. This is the field of insulation in which the Association has played an outstanding part for many years. There are few research groups in the world which make so significant a contribution to the practical engineering aspect of research on dielectrics.

The assessment of test methods for evaluating thermal endurance of varnished fabrics is a case in point. A report was issued on this subject during the year, with particular reference to tensile and tearing tests. These and other properties have been determined for cotton, silk, nylon and "Terylene," using various varnishes, with the object of proposing standard methods of estimating thermal endurance. A test device for assessing the corrosive effect of insulating sleeving has also been developed.

Much work has been done on the difficult question of assessing the resistance of insulating materials to the erosive action of discharges and the main factors affecting the test are now understood. Participation in international discussions on standard tests for electric strength, permittivity and loss angle has continued. At the I.E.C. Conference in Sweden, the British point of view prevailed regarding electrode systems for electric strength tests. A draft international document on measurement of permittivity and loss angle is based almost verbatim on an E.R.A. document.

The thermal endurance of enamelled wire is being assessed by means of the twisted wire test, and improved tests for other properties are being examined. Reports on better methods of testing the impact strength of solid insulating materials are being issued. The Norwegian tracking test for such materials has been assessed. It was proposed for international acceptance at the I.E.C. meeting in Sweden and some modifications were made in the light of E.R.A. criticism. A substantial improvement in the whole technique of tracking tests is likely to follow the successful design by the E.R.A. of an automatic tracking tester. This reduces very materially the manpower employed on a most tedious job.

Turning to more theoretical work, it is interesting to record that a forecast made by Liverpool University workers engaged on an E.R.A. programme that in strong fields electron mobility in semiconductors depends on the 0·8th power of the field strength has been confirmed by measurements made at Purdue University. In basic research on breakdown of liquids, partially supported at Queen Mary College by E.R.A., liquid argon as an experimental material has given results much more amenable to interpretation than is usual in this subject. Discoveries include an unexpectedly large influence of the anode material, and the importance of trace quantities of oxygen in solution, owing to its high electron attachment coefficient.

Organic impurities in pressboard used in the manufacture of capacitors have been shown to diffuse into the dielectric and increase the loss angle considerably whilst the capacitors are stored. A test cell for detecting organic impurities in any type of insulation has been designed and supplied to some 20 member firms. The test has been communicated to the B.S.I. for inclusion in a standard.

The Association's work on the formation of discrete cores to an electric arc is now being supplemented by a study of the arc boundaries, which are regarded as equally important. This study has been aided by a lenticular-plate high-speed camera giving 100,000 frames per sec. The accurate measurement of the high temperatures in arc and pinch discharges, which relies mostly on spectroscopic methods, is under continuous review. An experimental method in which the circuit constants before and after current zero can be made to differ has been devised to give more information on the nature of circuit severity. While still in its preliminary stages, the results already indicate that circuit severity is not necessarily simply related to restriking voltage.

Vacuum Switching

Work on vacuum switching has already given results of practical importance on certain medium- and low-power ranges. Further advances continue along these lines but the main preoccupation has been with explorations at high power where the release of gas from surface monolayers poses crucial problems. This is being supplemented by a contract from Harwell for the switching of very heavy currents.

The use of transmission voltages in excess of 200 kV has introduced a new problem in protection against lightning. The performance of such lines during thunderstorms is less satisfactory than would be expected from methods of prediction which have proved satisfactory for lower voltage lines. It is important that the reasons for this should be ascertained and the Association has

already begun an investigation to this end. Increasing use is being made by individual members of the facilities now available for the solution of surge problems. The E.R.A. lightning flash counter has been recognised internationally and is installed in large numbers in many parts of the world. The instrument installed at the laboratories recorded 1,858 flashes in a period of about three hours on 5th September, 1958.

With the steady increase in the use of electricity, sizes of individual items of equipment, including transformers, also tend to rise, and ability to withstand mechanical forces becomes a major problem. Very largely as the result of the work of the Association, the forces in transformers can now be calculated with sufficient accuracy, and attention has now been turned to the ability of materials, including copper, to withstand them.

Last year it was reported that, as a result of the E.R.A.'s research, it was possible to obtain a certificate for intrinsically safe circuits used in an atmosphere of ethylene. Now all the necessary research has been done to enable three other gases to be added, namely, carbon disulphide, isohexane and butadiene. Improved research techniques have shown the safe gap for hydrogen to be appreciably greater than hitherto accepted. It should now be possible to design flameproof apparatus for use in hydrogen and some of the other Group IV gases.

Network Analyser

The E.R.A. network analyser is now completed and is available for use on problems submitted by members and others. In view of its special advantages and unusual flexibility, members faced with network problems would be well advised to consider using the E.R.A. network analyser rather than automatically to think in terms of the more fashionable digital computer.

An extensive experimental installation at Pevensey for the investigation of vibration on overhead lines has been brought into service. A major initial difficulty was to ensure that lines constructed with some care to be identical should in fact behave similarly.

Plant environment has been the subject of an important research effort in the past and this continues, but agriculturists are now displaying interest in animal environment, and this might well lead to substantial outlets for the use of electricity for heating and lighting. Such work is done in co-operation with Reading University. An interesting example is research on the influence of day length and flash illumination on egg production of poultry. Extensive experiments, now completed, have led to the conclusion that an increase in the intensity or duration of lighting has no greater influence than the time, relative to natural dawn, at which the flashes of light are given. In other words, what matters most is the time at which the alarm clock is set—not its loudness or duration!

Significant results with artificial illumination for bulb growing are that tungsten filament lamps are better than fluorescent lamps, large lamps are as effective as an equal wattage of small ones, and that there is no advantage in raising the lamps as the plants grow.

Where wind power is used to generate electricity, one of the problems is to make full use of the available power at any time. The E.R.A. has applied for a patent to cover a device which will do this—the order of priority in which the loads are supplied being predetermined by the consumer. An 8 kW machine has been moved from Cranfield to an outstation of the Nature Conservancy at Aviemore and is being operated with such a device. A 25 kW machine, tested at Cranfield, has now been erected in the Isle of Man, where there is considerable interest in wind power. The machine is working in parallel with a diesel generator on a small network and is proving satisfactory. This is probably the first time such a scheme has been successfully used in this country. The Association has assisted the Ministry of Power with the installation, automatic control, and testing.

The Association's work on inductive interference is now completed with the publication of a substantial treatise on that subject by Dr. H. R. J. Klewe. The book is likely to stand to the E.R.A.'s credit for many years to come. The work on radio interference continues and is becoming of greater importance as a result of increasing international activity on the control of radio interference and the effect this is likely to have on exports.

Completion of experimental work on the first stage (up to 3,500 p.s.i. and 750 deg C) of the research on properties of steam may be noted. In parallel with the experimental work on the second stage (up to 15,000 p.s.i.), there is now in hand the evaluation of the results on the first stage on the lines agreed at the 1958 meeting of the International Commission on the properties of steam in Moscow, to which E.R.A. sent several delegates.

Researches on steel proceed satisfactorily. Bursting tests under creep conditions on thick-walled pipes have yielded their first results, which are of great interest. The whole creep programme has been closely reviewed, in preparation for its acceleration when the new creep laboratory is in commission. Work at B.I.S.R.A. on the mechanism of losses in silicon iron sheet shows that there are rewards to be achieved if the effects of nitrogen can be minimised. Two methods capable of application in practice are being examined. Researches in arc welding have led to the solution of some problems in metal transfer.

Apart from the building of a small office block at Shinfield, there have been no changes in the laboratory or other accommodation during the year. Three major decisions have, however, been taken: one to build at Leatherhead a laboratory for testing the creep of steel, another to transfer the staff at Thorncroft Manor to a new office building at Cleeve Road, and a third to vacate the small office accommodation which the Association occupies in the I.E.E. building.

The new creep laboratory and office building will be contiguous and situated near the present workshop and canteen building. The laboratory and its contents of creep-testing machines are being financed by the C.E.G.B. and other bodies and members interested in the creep of steels and in power stations. Plans for both buildings are now being prepared by the architects.

Overseas Section

An Overseas Liaison Section was established during the year and produced, in September, the first "Overseas News Letter" which will be issued twice yearly. The Association's weekly abstracts of technical literature were last year made available to non-members at five guineas a year, and some 25 sets are now sold on this basis. During the year 80 new technical reports were issued to members and about 19,000 copies were dispatched. Fifty reports were placed on the published list and 57 articles based on E.R.A. work were published in the technical Press or read before learned societies.

Membership at the end of 1958 totalled 374, viz. 257 ordinary members (239 manufacturers and 18 supply authorities), 60 associate members, 34 overseas members, and 23 associates. These figures include 22 new members, but the total as compared with the previous year has not increased correspondingly, since 11 resigned and there was a loss of nine by the absorption of separate members into groups.

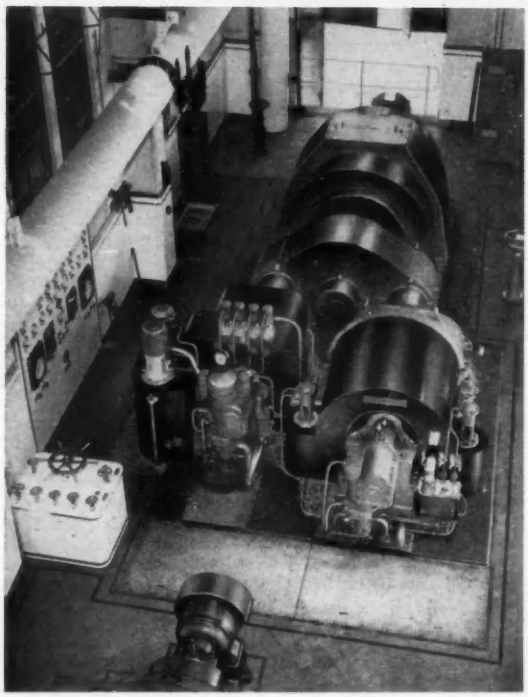
Generation from Process Steam

NEW 4 MW UNIT COMMISSIONED

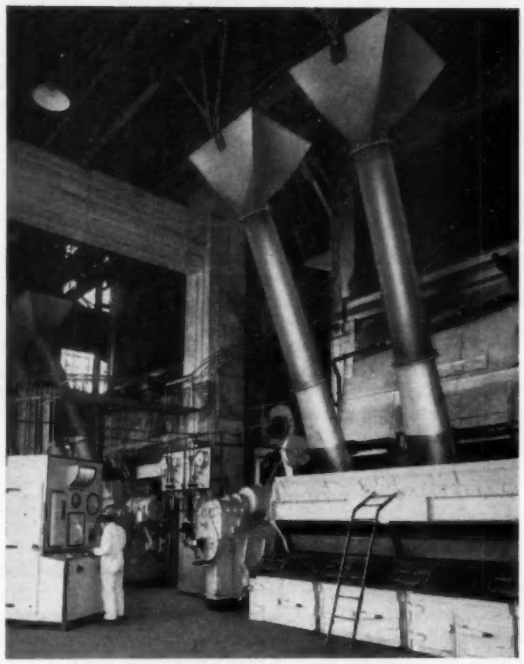
ELECTRICAL power for the Nottingham and Beeston factories of Boots Pure Drug Co., Ltd., is produced in the company's own power stations from steam used for chemical and pharmaceutical processing and, during the winter months, for space heating. These stations, one in each factory, are some four miles apart and are connected by two 11 kV cables to form one complete system for generation and for distribution, which is carried out through eight step-down transformer substations incorporating B.T.H. type B.V. switchgear providing 415 V for local use. In the Nottingham power station, a full description of which was published in the issue of the *Electrical Review* dated 4th February, 1955, all generation is a by-product of process steam, whilst at Beeston condensing generation is employed if insufficient power is obtainable from the process steam available.

Six Babcock & Wilcox chain grate water tube boilers are installed in the Beeston station, four of 30,000 and two of 40,000 lb/hr m.c.r. steam capacity, supplying steam at a pressure of 350 p.s.i. and 650 deg F, reduced to 60 p.s.i. for factory use. These boilers require 48,000 tons of coal per year, locally mined and brought to the station by road, and some 300 million gallons of make-up water obtained from the town mains and treated in a Neckar water softening plant. Five geared turbo-alternator sets receive steam from these boilers; there are a 750 kW, 415 V, G.E.C. straight condensing unit, a 1,000 kW, 415 V, G.E.C. back-pressure unit, a 1,500 kW, 415 V, B.T.H. pass-out condensing unit and a 4,500 kW, 11 kV, B.T.H. pass-out condensing unit, in addition to a newly-commissioned 4,000 kW, 11 kV unit. The 11 kV machines are connected directly to the ring-main system serving the two factories, while the 415 V units are connected through two 1,250 kVA, 415/11,000 V, Hackbridge transformers.

The new 4 MW set, showing the h.p. and l.p. cylinders driving the alternator through gearing



The new unit, which replaces the earliest set, a 1,000 kW back-pressure unit installed some 30 years ago, consists of a W. H. Allen two-cylinder multi-stage cross-compound pass-out condensing turbine, driving a B.T.H. air/water-cooled alternator at 1,000 r.p.m. through double-helical parallel shaft reduction gears, the h.p. cylinder running at 6,000 r.p.m. and the l.p. cylinder at 4,000 r.p.m. The steam conditions at the turbine stop valve are 340 p.s.i. at 630 deg F and the steam is passed through six h.p. and 11 l.p. stages, up to 96,000 lb/hr being passed out at the sixth stage of the h.p. cylinder at 60 p.s.i. for process use. A vacuum of 28·5in Hg is maintained in the condenser, which has a cooling surface area of 3,780 sq ft and a flow of 4,400 gal/min of cooling water with an inlet temperature of 65 deg F. This cooling water is obtained from the Trent Navigation canal. The set can be controlled to generate up to 3,000 kW condensing and 1,000 kW pass-out or up to 1,000 kW condensing and 3,000 kW pass-out depending upon the relationship between the requirements of the two factories



Nos. 5 and 6 boilers, with a Hagan automatic control panel

for steam and electrical power. The set, which occupies a floor area of 800 sq ft, including the surrounding walkways, has been installed in a position formerly occupied by the 1,000 kW unit, the foundations for the new set being built round the original foundation block.

One particular feature of the station is the high overall efficiency achieved. Since the steam is used for processing after generation—during which it loses some 7 per cent of its energy in dropping from 350 to 60 p.s.i.—a figure of over 60 per cent is obtainable. Approximately 80 per cent of the electrical load is composed of small motors from ½ to 5 h.p. for various duties throughout the factories. Other major loads are electrolytic plant and 45 h.p. motors driving soap mills, in addition to the cooling water pumps for the power station condensers and heat exchangers in the pharmaceutical and chemical factories.

In common with the national power system, the electrical demand has doubled in the last ten years, although during this time, as a result of the tendency to change from steam to electrical drives, steam consumption has increased only by about 20 per cent.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Inadequate Servicing Manuals

IN asking for better-written servicing manuals, you do a service to the industry's customers. Catalogues and brochures are of a high standard, as you say; they are produced by experts—the staffs of advertising agencies. The "book of instructions," presumably written by an engineer or electrician, is usually exasperatingly obscure and overlooks just the points on which its reader seeks guidance.

That is not the author's fault; he has done his best, but writing is not his job. Some day it will dawn upon managements that to convey information lucidly and concisely calls for just as much skill in the field of writing as does the designing of equipment in the technical world.

Journalists spend their lives learning the art, and those who succeed can command high salaries. If industry attaches any importance to goodwill after sales, it will have to lose the illusion that anyone can write an instruction manual so long as he has the scientific knowledge.

E.G.

Brushless Alternators

MR. FORD'S article in your issue of 17th April emphasises the need for the avoidance of brushes in aircraft generators. The machines described, however, do not seem to make much contribution to another important aspect in this field, namely, the ability to operate at high speeds.

The alternators described by Mr. Ford are handicapped by being confined to the established mode of construction employing circular stampings in the plane of rotation. By departing from this we may arrive at a form of alternator which embodies most of the advantages mentioned plus some of its own.

A design has been in existence for some years which is electromagnetically an entirely orthodox heteropolar alternator of very simple construction in which the only moving part is a robust pole piece of a shape suitable for the highest speeds.

This is achieved by making the armature core of coiled up magnetic strip exactly like a roll of tape slotted radially on both sides to receive the windings. Inside it is a hub magnetised axially by a stationary coaxial coil. End cheeks are milled to form poles which register with the sides of the core, making axial instead of radial air gaps. The poles are all of one sign at one end and the opposite sign at the other end. They would normally be assembled, however, so that viewed axially, alternate polarities would be seen equally spaced.

This construction was described in Patent Specification 628,018 which, however, was allowed to lapse after some years for want of support, but a special application of it is covered by 805,352.

A trial build has in fact shown promising results. Here, then, is a machine which, while preserving standard principles, is capable of pole speeds of 1,000 ft/sec or so, thus enabling high outputs to be obtained for given weights and permitting coupling to high-speed drives without gearing. It could be built into a gas turbine aero engine without adding anything to the outside and would have uses apart from the aircraft industry.

It may have more armature flux leakage and thus a higher reactance than standard types, but the magnetising power per pole when many poles are used is very high. Generally, there appear to be few penalties and it is well suited to large outputs. In aircraft applications frequencies would usually be higher than the standard 400 c/s, but if the output is rectified for use as d.c., this is more likely to be an advantage.

Derby. F. J. ALLEN.

British Association Meeting

THE 121st annual meeting of the British Association for the Advancement of Science will be held in York from 2nd to 9th September under the presidency of Sir James Gray, who will deliver an opening address entitled "The Proper Study of Mankind is Man." The preliminary programme contains the titles of the addresses of the presidents of 14 sections and some of the subjects that will be discussed in these sections, including the physical sciences and engineering, biological sciences, forestry and agriculture, geography, anthropology, archæology, economics, education and psychology.

A programme of illustrated lectures for young people from schools in the York area is being arranged and there will be a continuous showing of scientific films, while the extensive programme of excursions will include visits to industrial and commercial premises in York and the adjoining areas. Copies of the preliminary programme can be obtained without charge from the secretary of the British Association, 18, Adam Street, Adelphi, London, W.C.2, or from the local hon. secretaries, British Association Office, Guild Hall, York.

VIEWS on the NEWS

By REFLECTOR

ALL Electricity Boards adopt the practice of leaving meter-reading cards at the premises of consumers who are out when the meter reader calls. Usually the card takes the form of a diagram depicting the meter dials and all the consumer has to do is to copy the positions of the pointers. How well this works I have never inquired but I am sure it gives rise to many questions. Complete reading accuracy was recently achieved by an Eastbourne consumer who (says *Seeboard*) sent the local office of the South Eastern Electricity Board a photograph of his meter dials. I seem to remember, very vaguely, that I once heard of meter readers being equipped with cameras—or perhaps it was merely suggested. There might be something in it.

* * *

A year or two ago the electricity supply authorities introduced what they called a "productivity allowance" as an alternative to a straightforward wage increase. Naturally, this was regarded as a normal rise and it was not long before it had to be included in the basic wages. A postscript to this appears in a report from the Glasgow area of the Electrical Trades Union reproduced in *Electron* (the E.T.U. journal):—

> "The conversion of the productivity allowance in the electricity supply industry to a wage increase has given wide satisfaction, and it is hoped that there will be no repetition of this form of departure from the normal wage structure."

The electricity supply authorities may well regard this as ingratitude—but they might have expected it.

* * *

Another *Electron* item is a report, based on a T.U.C. investigation, upon the reluctance of women to join trade unions. One reason adduced for this shyness is in line with my note on the training of women engineers a week or two ago. It is said that there is a fundamental difference in the attitudes of men and women towards their jobs.

> "Men know that their work will generally continue at least until their retirement, whilst women consider work as a transition between school and marriage, when they are young, and later as a temporary obligation. They do not, therefore, attach such great importance to obtaining good working conditions, and they consider TU action with indifference."

It should be said, of course, that women's working conditions are specially covered by statute.

* * *

Bad weather is often responsible for stopping football matches and so is failing light. Nowadays the latter term has to be extended to "man-made" light for football is being increasingly played in the evening on floodlit pitches. While Shrewsbury Town were playing Watford one evening a week or two ago the floodlights suddenly ceased to function. It was thought that there had been some "sabotage" as the fuses were found to be missing. As the Electricity Board could not replace them quickly enough the match had to be abandoned. Shrewsbury were leading by five goals to two. The Watford Club have been fined £100 by the Football Association for not ensuring that their floodlighting was in order.

* * *

From some notes by "Touchwood" in the Spring issue of *London Electricity*:—

> "I like the spirit of the men in the industry today. I recently heard an ordinary electrician say that what he wanted to see was a 'really decent earth' and he affirmed that he wasn't going to be satisfied with anything less. This is no Frank Buchman or Billy Graham, just an ordinary British artisan going about his daily toil."

* * *

I have already mentioned a revival of interest in the United States in the electrically-propelled passenger car. Now I see that it is not only proposed to introduce new types of such cars, there is also a conversion scheme afoot. The *Electrical World* (New York) reports an interview with the head of a firm which proposes to replace the engines of "motor-weary autos" by electric motors. So far, it seems, tests have been carried out on only one car equipped with a 96 V, 130 Ah (8-hour rate) battery supplying a 5 h.p. motor. Speeds of up to 45 m.p.h. have been achieved but the range per charge is not specified. The firm hopes, with reduced weight and improved battery, to obtain speeds up to 60 m.p.h. and a range of 100 miles. Somewhat optimistically the head of the firm says that he is quite confident that by 1970 fully 50 per cent of the automobiles used in urban areas will be electrically propelled.

* * *

I am sure that I.E.E. meetings are much better than they were fifty years ago. At that time the *Electrical Review* (7th May, 1909) referred to the attempted limitation of speakers in discussions to ten minutes and remarked how difficult it was to enforce the rule. At a particular meeting "one speaker held the floor long after his due term had expired, practically defying the authority of the chair." Worse than this, another speaker

> "volubly delivered a lecturette on a point of theory which might have proved of value in a classroom but was unquestionably out of place in the presence of a body of professional men. . . . The time of the Institution is too restricted and valuable to be wasted in this way; and as it was, a large number of members who wished to speak, and whom the audience would have been glad to hear, were compelled to reserve their remarks for obscure interment in the *Journal*."

GENERATION and DEVELOPMENT

General view of the turbine hall at Bankside "A" station

Dismantling of Bankside "A" Station

As the next step towards the completion of the Central Electricity Generating Board's new Bankside station, the original "A" station was closed down on 24th March, after nearly seventy years' operation. Work has already begun on the dismantling of the plant, the contract for its disposal having been awarded to George Cohen, Sons & Co., Ltd.

Opened in 1891, Bankside "A" was a pioneer station, being for many years one of the largest in the country and responsible for supplying the whole of the power requirements of the City of London. The present plant has an aggregate capacity of 85 MW. The boilers include twelve Babcock & Wilcox Type C.T.M. installations, each with a capacity of 50 klb/hr at 250 p.s.i. and 606 deg F. Six are fitted with B. & W. chain grate stokers, two with Bennis chain grate stokers, and four have Wallsend burners for firing coal-tar fuel. Six Yarrow boilers of later date (65 and 75 klb/hr) have integral superheaters, Green's horizontal "Tri-tube" economisers, and Yarrow tubular air heaters. Five have twin Bennis chain grates, while the sixth is fitted with a Bennis carrier bar drop link type of grate. Evaporators and de-aerators were by G. & J. Weir and the condensing plant by Mirrlees Watson.

The generating plant consists of seven turbo-alternators—three Oerlikon and four B.T.H.—and a Parsons d.c. generator. Like the boilers, the generating equipment was installed over a long period and while certain of the older plant will, it is anticipated, be scrapped, some may be removed for use elsewhere, possibly overseas, such as the six Yarrow boilers, three of the B.T.H. sets and one Oerlikon set.

Estate Supply Terms

Easington Rural District Council is objecting to the North Eastern Electricity Board's terms for supplying electricity to 194 houses at Murton. Among other things, the Board has asked the Council to contribute £2,813 towards the cost of the work, but the Council's surveyor (Mr. R. R. Lumsden) has stated that this request is contrary to the "working formula" agreed upon in 1956. The Council is to take the matter up with the county branch of the Rural District Councils' Association.

London Floodlighting

As from last week public buildings in London are again being floodlit during the summer from lighting-up time until midnight. Electricity for the floodlighting, which continues until 27th September, is being supplied free by the London Electricity Board.

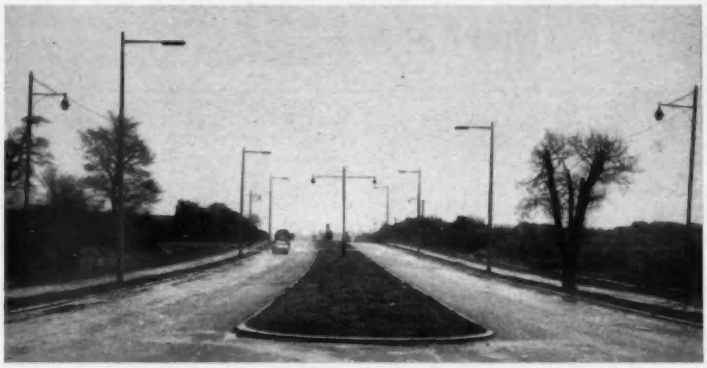
Ulster Board's Borrowing Powers

A Bill to increase the borrowing powers of the Electricity Board for Northern Ireland was given its second reading in the Ulster House of Commons recently. Lord Glentoran, Minister of Commerce, said that the Board needed additional money to meet the cost of the new power station at present under construction at Coolkeeragh, the interconnection of the station with existing stations at Islandmagee and Belfast, and the extension of the distribution system to meet the increasing demand for electricity supplies. Lord Glentoran said that the Board's issued capital at 31st December last amounted to more than £18·5 million, made up mainly of £8 million raised by the issue of stock, £6 million borrowed from the Government Loans Fund, and £4·3 million of bank loans and short-term deposits. The position was that the present limit of £20 million would soon be reached in defraying the Board's liabilities on capital account. The Bill proposed to raise the authorised capital to £30 million and it might be expected that further provision would have to be made, probably as early as 1961 or 1962.

Experimental Lighting for Main Traffic Roads

In conjunction with Mr. Granville Berry, city engineer and surveyor of Coventry, the Revo Electric Co., Ltd., has installed a trial scheme of six lanterns with the new Philips 280 W sodium lamps along the Coventry By-Pass. The lanterns are mounted at a height of 35ft on Adastra tapered steel poles, spaced at intervals of 200ft on each 22ft carriageway, between which there is a 15ft central reservation. The poles are erected on the outer kerbs only and the lighting is considered adequate for driving at high speeds without using headlights. The number of lanterns involved in lighting a dual road by this method is approximately 40 per cent less than is normally recommended with standard equipment at 25ft mounting height. Each lamp has an overall length of 943 mm and light control is obtained

Photograph taken in the turbine room at Owen Falls power station during the recent visit of the Minister of State for Colonial Affairs (Lord Perth) to East Africa. Left to right: Mr. T. Eckersley, generation engineer, Uganda Electricity Board; Lord Perth; Mr. W. D. D. Fenton, chairman of the Board; Sir Frederick Crawford; Sir Amar Maini, Minister of Commerce and Industry, Uganda; and Mr. E. H. Wilson, secretary of the Board



Revo trial installation along the Coventry By-Pass. The mounting height of the lanterns is 35ft and the columns are 200ft apart

by specially formed "Perspex" refractor panels providing about 7,000 lumens per 100ft on each carriageway.

Road Heating in Tunnel Approaches

A plan to install an electric heating system to prevent the formation of ice along the twin approaches to the Clyde tunnel is under consideration by a committee of Glasgow Corporation. The estimated cost is £15,000 and the Scottish Home Department has indicated that the scheme would qualify for a 75 per cent grant, but the Corporation would have to undertake the cost of maintenance.

OVERSEAS

Power from Kariba

The chairman of the Federal Power Board of Rhodesia and Nyasaland told a Press conference recently that the Kariba hydro-electric scheme on the Zambesi River would start supplying power to the Copperbelt early next year. Salisbury and Lusaka, he said, would be getting supplies towards the end of next year and Bulawayo after March, 1961.

Projected Chilean Stations

The *Fortnightly Review* of the Bank of London and South America reports that the Cia. Chilena de Electricidad proposes to install two new 100 MW thermo-electric plants during 1961-63. One, at Carrascal (Santiago), will burn small coal and the other, at Concón (Viña del Mar), will be oil fired.

N.S.W. Transmission Schemes

Work is to begin shortly on a major high voltage transmission line to feed power from the Snowy Mountains and the Tallawarra power station into the New South Wales electricity network. Tenders for the line closed last month. At Tallawarra a 100 MW generator now on order from Britain will increase the station's capacity next year to 220 MW and from the Snowy Mountains T1 hydro-electric station at Cabramurra more than 200 MW of power will be fed into the State network through the new Yass substation, making new demands on the transmission network.

The new line will be the third 132 kV circuit to come into service between Tallawarra and Sydney. At the end of 1961 the line will be energised at 330 kV to feed into the new £2 million Sydney South substation, on which work will begin in a few months' time. The construction of a five-mile steel tower transmission line from the site of this new substation to Bankstown will also begin this year.

In the north the Electricity Commission is surveying a 120-mile power transmission route from Armidale to Grafton. The line will run from the site of a proposed 330 kV substation at Armidale to a substation near Koolkhan power station, Grafton. Construction of this line will present a major problem for engineers because the route climbs to an elevation of 4,500ft near Ebor and descends to sea level at the Orora River between Nymboida and Grafton. A span of 4,000ft will be required for the river crossing.

Nuclear Power in France

The second nuclear reactor station (G.2) at Marcoule, the French atomic research centre, recently began to feed power into the public electricity supply system. Although primarily designed for plutonium production, the station will continue to supply electricity to the public system.

Parliamentary Report

Safety of Nuclear Installations

The necessity of taking precautions to deal with any special circumstances that might arise as a result of an accident or emergency at a nuclear power station was emphasised by Mr. Palmer during the committee stage of the Nuclear Installations (Licensing and Insurance) Bill. Moving an amendment that the Minister, in attaching conditions to the granting of a licence, should have regard for such precautions, he said they were anxious that the Minister should not look only at circumstances which were normal at an atomic plant where everything was going properly according to routine but should take account, in this largely uncharted area, of all the contingencies which might possibly arise.

He had asked previously whether the Minister, when drafting the safety regulations, would make provision for the evacuation, if necessary, of the entire staff of a power station feeding into the national grid, in the event of a nuclear radioactive leak. It was only fair to those in charge to ensure that the stations were designed in such a way that in the event of necessity the whole of the staff could be moved out with safety.

His argument impressed Mr. Maudling, the Paymaster General, who said the Government would consider whether an amendment on the lines suggested by Mr. Palmer could be put into the Bill at a later stage.

When an Opposition amendment was moved which sought to ensure that the Minister, before attaching conditions to a licence, would consult with the local authorities concerned and the organisations representing the workers likely to be employed at the site, Mr. Palmer said he strongly advocated consultation with the representatives of trade unions before a licence was granted.

In the electrical power industry, where a committee had been established by the Generating Board to examine the domestic safety regulations being drawn up for nuclear safety, the trade unions had nominated a representative of their own to sit on that committee. Their representative had considerable expert knowledge.

Sir Ian Horobin, Parliamentary Secretary to the Ministry of Power, said the Government felt that the local authority, as the planning authority, had all the cover required. The power stations had already the protection of the Electricity Acts which laid down very elaborate provisions for public inquiry and so on. As regards consultation with the workers on the specific safety aspect, he thought the arguments were very much stronger, but there was an amendment to come later on this subject which the Government might be able to consider sympathetically. The amendment was defeated.

Tax on Radio Valves

Asked by Mr. Arthur Lewis if, in view of his decision to abolish purchase tax on television tubes, he would now remove purchase tax from radio valves used for maintenance purposes, Mr. Heathcoat Amory, Chancellor of the Exchequer, replied in the negative.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The annual general meeting of the Aluminium Development Association was held on 17th April when the annual report was presented by the retiring president, **Mr. S. E. Clotworthy.** In surveying the year's work the president expressed satisfaction with the extent to which progress had been maintained and in several directions accelerated. **Mr. Rudolf Hahn** was elected president of the Association for 1959-60. Mr. Hahn represents, on the A.D.A. Council, the Association of Light Alloy Refiners and Smelters, Ltd. He is a native of Berlin where, in 1921, he joined the family tube works, and was mainly engaged in the steel industry until 1938, when he decided to leave Germany with his family to make his home in England. Mr. Hahn then joined the newly formed company of B.K.L. Alloys, Ltd., manufacturers of aluminium alloy ingots, of which he is now chairman and managing director. Mr. Clotworthy (managing director, Northern Aluminium Co., Ltd.) was elected vice-president of the Association.

Mr. R. Hahn

Consequent on the retirement of **Mr. S. Wright,** C.B., J.P., of the Ministry of Power, from the public service on 30th April, **Mr. M. P. Murray,** C.B., has been appointed to succeed him as Director of Establishments. **Mr. O. Francis** has been transferred to succeed Mr. Murray in charge of the Electricity Division and **Mr. J. A. Beckett,** C.M.G., has been promoted to the rank of Under-Secretary and succeeds Mr. Francis in charge of the Gas Division.

Newmarket Transistors, Ltd., announces the following appointments under **Mr. D. Q. Fuller,** A.M.I.E.E., M.I.R.E., director of engineering:—Chief physicist, **Mr. G. Roman,** Dipl.Ing.; chief production engineer, **Mr. J. B. Haggis,** Graduate I.E.E.; and chief development engineer, **Mr. T. D. Towers,** M.B.E., M.A., Graduate Brit.I.R.E.

The research laboratories at Heston, Middx., of Atomic Power Constructions, Ltd., have been completed and **Dr. R. J. Eldred,** B.Sc.(Eng.), Wh.Sc., M.I.Mech.E., A.M.I.E.E., has returned to head office to continue his normal duties. The permanent laboratory executives at Heston are as follows:—**Mr. H. E. Dixon,** M.Sc., F.I.M., head of research and development, and **Dr. A. G. H. Coombs,** B.Sc., A.I.Mech.E., deputy head of laboratories. **Mr. D. C. F. Lunn,** F.I.M., formerly deputy chief metallurgist, has been appointed chief metallurgist to fill the vacancy created by Mr. Dixon's appointment. Mr. Lunn will be normally at the head office.

The Minister of Power has appointed **Sir George Briggs,** A.M.I.Mech.E., of St. James's, London, as a part-time member of the London Electricity Board. Sir George is managing director of Hawker Siddeley Industries, Ltd., and a director of Thomas Tilling, Ltd., and other companies.

Mr. R. S. Hewitt has joined the board of Elliott Brothers (London), Ltd. Mr. Hewitt started his career with Elliott Brothers in 1928 and is deputy controller of Elliott-Automation, Ltd.

Mr. M. E. Peplow, B.Sc., A.Inst.P., A.M.I.E.E., formerly senior assistant engineer at the Leatherhead Research Laboratories of the Central Electricity Generating Board, has been appointed regional research and development officer for the Southern, South Western and South Wales Region of the Board.

Mr. Peplow was educated at Wolverhampton Technical High School and later at Birmingham University. After holding positions with J. Sankey & Sons, Ltd., G.K.N. Research Laboratories, Wolverhampton, the Armaments Research Establishment, Swynnerton, and A. Reyrolle & Co., Ltd., he joined the Central Electricity Authority in 1953 as a 2nd assistant engineer (physicist) at the Research Laboratories, Leatherhead, and was promoted to senior assistant engineer in 1956.

Mr. D. Q. Fuller

Mr. G. Roman

Mr. J. B. Haggis

Mr. T. D. Towers

At the annual general meeting of the Association of British Ebonite Manufacturers, held on 30th April, **Mr. A. W. Hopkins,** of the General Electric Co., Ltd., was re-elected chairman for 1959-60.

Sir Alexander Sim, chairman of W. T. Henley's Telegraph Works Co., Ltd., has been appointed to the board of Siemens Edison Swan, Ltd., and has also become a member of that company's group management committee.

Mr. C. H. Noton, M.Sc., Ph.D., F.Inst.F., M.S.M.A., has been appointed commercial manager of Semiconductors, Ltd., Swindon. He will take over responsibility for the co-ordination of all commercial activities resulting from the expansion of the company's interests in the manufacture of transistors and other semiconductor devices. Dr. Noton was previously managing director of Genatosan, Ltd., and, before that, sales director of Fibreglass, Ltd. During the war he served with the Royal Artillery, and was later with the Ministry of Economic Warfare and the Foreign Office.

Dr. C. H. Noton

Mr. W. Hackett, Junr., and **Mr. R. D. Young,** B.Sc., have been appointed assistant managing directors of Tube Investments, Ltd.

Mr. J. Sandiford has joined Dr. Beck & Co. (England), Ltd., in the capacity of technical manager. Mr. Sandiford was previously with the Concordia Electric Wire & Cable Co., Ltd.

We should have stated, in referring to the recent appointment of **Mr. H. Walker,** B.A., M.I.P.M., in our issue of 24th April, that he had been appointed assistant manager, staff recruitment and training, with the Metropolitan-Vickers Electrical Co., Ltd. This was not made clear in our notice.

Mr. G. H. Moir, whose retirement from the position of area manager in Northern Ireland for the General Electric Co., Ltd., was reported in our issue of 17th April, was recently

entertained to dinner at the Midland Hotel, Belfast. Mr. R. P. Watson, city electrical engineer, Belfast, presided, and the dinner was also attended by the Lord Mayor of Belfast and representatives of all sections of the electrical industry in Northern Ireland. Mr. Moir has been an active member of local technical education committees and these were also represented. He was presented with a gold wristlet watch and his wife and daughter also received gifts.

Mr. W. P. Warren, B.Sc., M.I.E.E., formerly commercial manager of the Industrial Group of the United Kingdom Atomic Energy Authority, has joined the Powell Duffryn group of companies as sales director of the subsidiary company, Cambrian Wagon & Engineering Co., Ltd., at Cardiff. Before joining the U.K.A.E.A., Mr. Warren was with Metal Industries, Ltd., as general manager of Cantie Switches, Ltd. After early training and appointments with the General Electric Co., Ltd., he joined the South Wales Electricity Board in 1948, where he became assistant chief commercial engineer in charge of industrial supplies and development throughout the South Wales area.

Mr. H. de A. Donisthorpe, deputy manager of the former Valve and Electronics Department of the General Electric Co., Ltd., has retired. Mr. Donisthorpe has been associated with the thermionic valve throughout his career, and was one of the three officers who introduced the valve to the B.E.F. in 1914. He first joined the G.E.C. in 1926 as a special sales representative for "Osram" valves. His official activities with the Radio Industries Club, the Electrical Industries Club and the Electrical Industries Benevolent Association will be continued. His address is 10, Grenville Place, London, S.W.7 (telephone: Frobisher 0975).

Mr. H. de A. Donisthorpe

Mr. S. A. Hiscock, M.Sc., A.I.M., has been appointed to the staff of the Lead Development Association and will be principally engaged in duties associated with developments in the use of lead in the cable industry. He was previously with Enfield Cables, Ltd.

Mr. W. A. Walker, A.M.I.E.E., A.S.M.A., has been appointed commercial officer of the Ayrshire Area of the South of Scotland Electricity Board. He is at present commercial officer of the Dumfries and Galloway Area and has been with the Board and its predecessors since 1951.

Mr. W. M. Clark, chief of transformer sales at the head office of Bruce Peebles & Co., Ltd., has been

Mr. W. M. Clark

Mr. L. B. Torond

appointed manager of the Glasgow office. **Mr. L. B. Torond,** assistant manager, London, has been appointed manager of the London office.

Mr. Clark and Mr. Torond succeed **Mr. J. H. P. de Villiers** and **Mr. N. L. Jones,** respectively, both of whom have been appointed divisional directors.

Mr. J. B. Woodeson and **Mr. K. J. McKillop,** chairman and director, respectively, of the Water-Tube Boilermakers' Association left London by air for Moscow on 4th May to explore the export market for British steam-raising plant. They are to head a five-man delegation from member companies which has already arrived in Russia. During the tour the British party hopes to discuss technical problems of common interest and to see something of the latest Russian techniques in the development of water-tube boilers for generating stations and for marine use. The members will also discuss the Russian requirements and see what can be done to increase the export to the Soviet Union of British steam-raising plant.

At a general meeting of the Essex Branch of the **Electrical Industries Benevolent Association** held last month the following officers were elected:—Chairman, Mr. W. E. Wardrop, Associate I.E.E.; hon. secretary, Mr. E. E. Cooper; hon. assistant secretary, Mr. E. H. Nicholls; and hon. treasurer, Mr. C. Merrells, A.I.M.T.A., D.P.A. All are with the Eastern Electricity Board.

In our last issue we reported the appointment of **Mr. H. Jackson,** B.Sc.(Eng.) (London), M.I.E.E., M.I.Mech.E., to the position of deputy chief commercial engineer to the South Wales Electricity Board. We have since received a copy of Mr. Jackson's portrait which we now reproduce.

Mr. H. Jackson

Over 250 employees from the Bridgend Works of **Line Equipment, Ltd.,** with their wives and friends, were entertained by the directors to a dinner and social evening recently at the City Hall, Cardiff. The guests were welcomed by Mr. P. H. Jackson, who recalled that the company had been in existence for thirteen years and he referred to its growth. Mr. P. Bowthorpe responded for the guests and a toast to the company was proposed by Mr. S. Figgis. Mr. J. Bowthorpe (chairman) indicated that although conditions generally were more difficult, more equipment had been produced and sold during 1958 than ever before. Additional premises for the production of h.v. fuses only had been acquired.

Arrangements have been completed for the proposed Golf Day of the **Electrical Industries Club.** The date is 22nd June and the course the Walton Heath Golf Club, Tadworth, Surrey. Entries should be sent to Mr. J. J. Thompson, Berry's Electric, Ltd., 85-86, Newman Street, London, W.1. The Club is to meet the Birmingham Electric Club at golf at Frilford Heath, near Oxford, on 8th July.

The president of the Electrical Power Engineers' Association for 1959-60 is **Mr. R. Johnson,** station superintendent of the Clyde's Mill power station of the South of Scotland Electricity Board.

Mr. R. Johnson

Mr. Johnson was educated at Bellahouston Academy, the Technical College, and the College of Marine Engineering in Glasgow. He served his apprenticeship with Dunsmuir & Jackson, Ltd., Govan, and his post-apprenticeship with the Fairfield Shipbuilding & Engineering Co. and Cammell Laird. Afterwards he spent some years at sea with Elders & Fyffes and Canadian Pacific Steamships, Ltd., returning to shore work in 1936, when he joined the staff of the former Clyde Valley Electric Power Co., which he served in various capacities until, in 1947, he was appointed deputy superintendent at Clydes Mill power station. After a period at Yoker power station he became, in 1957, superintendent at Clydes Mill. He joined the E.P.E.A. in 1942 and was elected to the National Executive Council, representing then the Scottish Division, in 1950. Later, Mr. Johnson was appointed to the Council as a spokesman for managerial members. He is a member of the National Joint Board and the National Joint Advisory Council for the Electricity Supply Industry.

The annual dinner of the **Cable Makers' Football Cup Competition** was held on 25th April at Coventry Street Corner House, London, and followed the final, between British Insulated Callender's Cables (Prescot) and Southern United Telephone Cables (an associated company of Henley's), which had earlier been played on the ground of Ripaults

Co., Ltd., Enfield, Middx. (The match ended in a draw and the two teams therefore became joint holders of the trophies.) At the dinner the chairman was Mr. W. A. H. Brown. Mr. G. L. Rogers, proposing the toast of the guests, welcomed the many representatives of the Football Association Council who were present and, replying on behalf of the guests, Dr. A. W. Barton, M.A., B.Sc., member of the F.A. Council, said he was glad to know that the competition would go on despite the present changes occurring in the Cable Makers' Association. In presenting the trophies and medals, Mr. J. S. A. Bunting said that it was the second time in the history of the competition that two teams had become joint holders of the trophies. Among the representatives of the companies concerned in the competition who attended the dinner were a number of members of the boards of the various cable companies.

The Eastern Electricity Board has appointed **Mr. C. C. Brazier,** A.M.I.E.E., at present a deputy sub-area engineer with the Midlands Electricity Board, to be the sub-area engineer of the Norfolk Sub-Area in succession to **Mr. W. S. Kelly,** who was recently appointed the Board's purchasing officer. Before nationalisation Mr. Brazier held various appointments in the supply industry in Yorkshire and Lancashire and after nationalisation was appointed second assistant district engineer in the Barnsley district of the Yorkshire Electricity Board. He joined the Midlands Electricity Board in 1952 as senior assistant planning and technical engineer in the Shropshire and Herefordshire Sub-Area and was later appointed deputy sub-area engineer. For the past six years Mr. Brazier has been a part-time lecturer at the Shrewsbury Technical College and was for some time the secretary of the West Midlands Engineering Society.

Mr. C. C. Brazier

Mr. N. Dixon, A.M.C.T., A.R.I.C., F.I.R.I., for many years chief chemist and later technical manager of the Rubber and Plastic Division of W. T. Glover & Co., Ltd., has retired; he completed fifty years' service with the company last year. To mark his retirement the directors held a dinner at the Normandy Hotel, Knightsbridge, when Mr. D. T. Hollingsworth (director and general manager), on behalf of the directors, presented Mr. Dixon with a gold wrist watch. Mr. Dixon was an original member of the C.M.A. Technical Committee, has served continuously and has twice been chairman of the R.C.M.A. Technical Committees. During the last war he was a member of several committees and panels of the Cable Makers' (War Emergency) Technical Committee and has represented the C.M.A. on B.S.I. committees.

The British Central Electrical Co., Ltd., announces that **Mr. C. G. Marks,** general manager, has also been appointed sales manager and assumes responsibility for the whole of the company's sales activities. Mr. Marks, who served his apprenticeship with the B.T.H. Co., Ltd., Rugby, joined the staff of the British Central Electrical Co. in 1950 as personal assistant to the managing director. He was appointed general manager in 1955.

Mr. C. G. Marks

Mr. K. T. B. Askins has been appointed Southern Area manager of the Ferguson Division of Thorn Electrical Industries, Ltd. He continues as sales promotion manager of the Division and in his further appointment will be responsible for the management in South Wales, the Western, Southern and Home Counties. **Mr. E. T. Rose** has been appointed London Area manager of the Ferguson Division and will be responsible for the management of the Greater London and Eastern Counties territories. Mr. Rose has been with Ferguson Radio for many years, covering the East and North London Area.

OBITUARY

Mr. Oswald Leonard Robson, M.B.E., B.Sc. (Eng.), M.I.E.E., A.I.Mech.E., manager of the Rectifier Department of Bruce Peebles & Co., Ltd., Edinburgh, died suddenly on 28th April at the age of fifty-six. Born at Ilford, Essex, Mr. Robson received his early practical training with the British Electric Transformer Co., Ltd., Hayes, Middx., and became a transformer designer. He joined Bruce Peebles in 1927 as a transformer designer and graduated B.Sc.(Eng.) at London University in 1931. During the pre-war years he held various appointments in England. He served with the Royal Engineers during the war, attaining the rank of major, and was awarded the M.B.E. for his work in bomb disposal. After the war he rejoined Bruce Peebles as chief rectifier designer and in 1953 was promoted manager of the Rectifier Department.

Dr. F. Busemann.—The death occurred on 30th April of Mr. F. Busemann, Dr.Ing., deputy head of the Transmission and Utilisation Department of the Electrical Research Association. Dr. Busemann came to this country from Germany under the Department of Scientific and Industrial Research Darwin Scheme as an expert on high voltage d.c. transmission and commenced work for the Electrical Research Association in July, 1946. His work was so successful that application was made for permission for him to stay in Britain permanently. This was granted and he joined the permanent staff in 1948. In addition to the h.v. d.c. work, he also gave his attention to a variety of network problems. Particularly outstanding was a very successful series of tests on system stability carried out at Cliff Quay in collaboration with the Central Electricity Authority, an account of which was given in an I.E.E. paper. Recently he had been engaged on research into the utilisation of electric power cables. He served as an expert on a number of British Standards Institution committees and also on international committees, and was the author of numerous papers.

Sir William Larke.—The death occurred on 29th April, at the age of eighty-four, of Sir William James Larke, K.B.E., D.Sc.(Hon.), (Dunelm), M.I.E.E., M.I.Mech.E., F.Inst.F. Sir William, after service with Siemens Bros. & Co., Ltd., was with the British Thomson-Houston Co., Ltd., from 1898 to 1915, with which company he became manager of the Power Mining Department and executive engineer at Rugby. He was with the Ministry of Munitions from 1915 to 1922, following which he became director of the British Iron and Steel Federation, a position he held until 1946. He was a past-president of the Institute of Fuel, of the Institute of Welding, the British Standards Institution, the Junior Institution of Engineers, the Institution of Engineers-in-Charge, and the British Welding Research Association. He was an hon. member and a vice-president of the Iron and Steel Institute, which awarded him the Bessemer Gold Medal in 1947, and he also received the Fox Gold Medal of the Institute of British Foundrymen in 1953.

Mr. Lawrence Edward Levett, branch manager of the South Western Electricity Board at Tavistock (Devon) since 1948, died on 2nd May at the age of sixty-three.

Mr. T. G. Bloomfield.—The death occurred in his home in Surrey on 3rd May, at the age of fifty-five, of Mr. T. G. Bloomfield, who for the past twenty years had been a director of Batwin Electric Motors, Ltd., Richmond, Surrey.

Mr. John Mair, B.Sc., M.I.Mech.E., London manager of Glenfield & Kennedy, Ltd., since 1939, died on 3rd May. Before coming to London Mr. Mair had acted for sixteen years as chief engineer to the company in India.

Mr. Ronald Pattenden, chief buyer of Measuring Instruments (Pullin), Ltd., died suddenly on 24th April.

INDUSTRIAL NEWS

A.E.U. Conference

At last week's annual conference of the Amalgamated Engineering Union a proposal by the president, Mr. W. J. Carron, that precedence should be given to the Union's claim for a 40-hour week over its demand for higher wages was rejected. Instead it was resolved that both claims should be pressed simultaneously. An amendment calling for an overtime ban and a one-day strike in support of the claim for a shorter working week was defeated.

It was unanimously decided to submit a claim for a 15 per cent increase in wages to date from the time of application. This claim will be made through the Confederation of Shipbuilding and Engineering Unions and will affect about three million people. Another resolution was passed calling for a 40-hour week in the nationalised industries.

Mr. Carron was re-elected president of the Union for a further five-year period.

It was agreed at the conference to nominate Mr. F. Foulkes, general president of the Electrical Trades Union, as next president of the Confederation of Shipbuilding and Engineering Unions. With this backing and that of the E.T.U. his election is virtually assured.

Russian Tyre Factory

At a Press conference in London last week details were given by the Dunlop Advisory Service, Ltd., of the new tyre factory to be built in Russia by a consortium of British companies operating under the name of Rustyfa, Ltd. Dunlop Advisory Service, Ltd., is at present mainly engaged as consultants to the consortium and its work has made possible the sale from this country of approximately £14 million of engineering service plant and rubber and tyre manufacturing machinery for the new factory. The factory will be built at Dniepropetrovsk near the Dnieper River and will cover an area of 79 acres. It is anticipated that all the necessary machinery will have been shipped to Russia by the end of this year and that the factory will be in production during 1960. Output will be concentrated on car, tractor and earth-mover types of tyres.

Electric power for the site is to be brought by overhead transmission lines at 154 kV and transformed to 6 kV through two 31,500 kVA transformers. The 6 kV supply will be fed to a 27-panel main switchboard for distribution via ring mains to eleven substations. In these substations five 14-panel switchboards will supply power by ring mains at 6 kV to the main motors (four 1,500 h.p. and nine 1,000 h.p.) driving the heavy mixing and processing machinery, and for low voltage supplies eighteen 1,000 kVA transformers will be provided for reducing the voltage from 6 kV to 380 V. The h.v. and l.v. electrical distribution system will have interconnections to ensure continuity of service and mimic diagrams will be used wherever visual indication is desirable to observe remote conditions.

The following companies are the members of Rustyfa, Ltd.:—David Bridge & Co., Ltd., Crompton Parkinson, Ltd., Lancashire Dynamo (Holdings), Ltd., Mather & Platt, Ltd., and Francis Shaw & Co., Ltd.

Moscow Trade Mission

The names of the business men who will accompany Sir David Eccles, President of the Board of Trade, as members of the Trade Mission to Moscow, were announced last week. They are Sir Hugh Beaver, a past-president of the Federation of British Industries and managing director of Arthur Guinness, Son & Co., Mr. J. B. Scott, sales director of Crompton Parkinson, Ltd., and chairman of the Russian Section of the London Chamber of Commerce, Mr. J. S. G. Clark, a past-president of the Timber Trades Association and a director of Churchill & Sim, timber agents and brokers, and Mr. L. W. Phillips, a past-president of the National Federation of Corn Trades Associations and a director of the T. A. Jones Company, grain brokers. The Government representatives will be Sir Frank Lee, Permanent Secretary of the Board of Trade, Mr. C. D. Campbell, head of the Commercial Relations and Export Section of the Board of Trade, and Mr. A. E. Percival, who was with the Board of Trade before joining the Export Credits Guarantee Department.

Good Film Performance

The private showing of an otherwise good film is often marred by indifferent projection. With industrial films playing an increasingly large part in educational training and advisory work, the Electrical Development Association has published an illustrated booklet, "Your Film Show," in the interests of better projection and successful private film shows. Practical hints are given on how, when using premises not built as a cinema, to keep out unwanted light; the positioning of the screen; the size of picture; the arrangement of seating for the audience; the setting up of the projector; the placing of the loudspeaker; advance preparation and inspection of the spools of film; and the use of refinements, such as interval music and dimmers for the lighting of the hall. Copies of the booklet can be obtained from the Electricity Boards or direct from E.D.A. at 2, Savoy Hill, London, W.C.2.

Nickel Alloys Exhibition

A four-day exhibition illustrating the properties and uses of nickel and its alloys is to be held by Henry Wiggin & Co., Ltd., at Park Lane House, 45, Park Lane, London, W.1, from 12th to 15th May. The exhibition will include displays showing the various special properties of the Wiggin alloys — heat resistance, corrosion resistance, electrical resistance and special physical properties. The exhibition will be augmented by film shows and a series of lectures.

Automatic Programming

During last week a demonstration was given in London by the English Electric Co., Ltd., of automatic programming equipment for the control of rolling mills and other large items of industrial plant having an operating sequence or movement pattern. The demonstration was made in a vehicle, fitted with a full-sized equipment controlling a one-eighth scale working model of a steel rolling mill, which has recently made a tour throughout the country. At present most rolling mill drives use manually operated levers to control the movements of the roller tables, the adjustment of the distances

Model rolling mill installed in the demonstration vehicle

between rolls and the manipulation of the metal into the correct rolling channel, in addition to the main mill drive. These operations follow a definite movement pattern and can be reproduced in electro-mechanical form after storage in a memory system. A number of rolling programmes can be made up to suit a variety of types and size of metal and stored, to be selected for later use by a push-button.

The equipment comprises a number of standard units incorporating G.P.O. type motorised and ratchet operated uniselectors for programme storage, their use being developed from an original suggestion by the British Iron and Steel Research Association, in addition to relays for local sequencing and interlocking, and resistors for the production of output reference signals. Each standard unit, which controls one function, can store up to 50 programmes, each programme having a maximum of 15 passes. Plugboards allowing new, experimental or uncommon programmes to be accommodated are supplied, a selection of roll gap, mill speed, and roll channel being made for up to 15 passes. When a programme giving the desired result has been obtained, it may be wired into the permanent store if required for further use.

The complete programming equipment includes over-riding manual control, interlocking, and indicator lamps which show the programme selected and the number of the pass being carried out, while provision has been made for the automatic compensation of roll wear in the roll gap setting. The advantages claimed for this type of control include consistent product quality, greater productivity, reduced mill maintenance and a more efficient use of operating personnel.

Industrial Arts Bursaries Exhibition

The winning and commended designs submitted in the Industrial Art Bursaries Competition organised by the Royal Society of Arts in 1958 are on view at the Society's house, John Adam Street, London, W.C.2, until 15th May. The exhibition will be shown subsequently at the Belfast, Birmingham, Edinburgh, Falmouth, Newcastle-upon-Tyne, and Stoke-on-Trent Colleges of Art.

The jury report that not only did twice as many candidates enter in the domestic electrical appliances section as in 1957, but that their work was of an even higher standard. The number of schools participating also increased. The set test this year was for a 2 kW convector heater, and the bursary was awarded to Mr. Leslie Wolf, of Newcastle College of Art and Industrial Design. Mr. Wolf and a runner-up, Mr. J. F. Wickham, of the L.C.C. College of Arts and Crafts, were also commended for their designs for battery-operated pot scourers.

At the opening of the exhibition last week, Sir Harry Pilkington suggested to the winners that they should not use their bursaries, as had often happened in the past, to "pick the brains" of designers in Scandinavia and elsewhere, but that they should travel with the aim of studying the market for British goods and the requirements of customers.

Farm Electrification Course

Last week fourteen members of the staff of the Merseyside and North Wales Electricity Board, whose duties bring them into contact with farmers, attended a course on "Farm Electrification" at the Glynllifon Agricultural Institute, Caernarvon, at which they received instruction in the form of lectures from experts of the National Agricultural Advisory Service, the Agricultural Department of Bangor University, and the Electricity Council. The programme was part of a three-week course, and the other two weeks' training will be carried out during 1960. The Board's first batch of specialists in this field were trained during 1955-57 but transfers and promotions have made it necessary to train additional staff in order to maintain the Board's capacity to guide and advise on farm electrification. This policy is visualised as a continuous process. Subjects studied at last week's course included livestock feeding, soil fertility and fertilisers, the use and conservation of grassland, grass drying, clean milk production, pig breeding, and farm management. The course was officially opened by Mr. D. H. Kendon, chairman of the Board.

"The Story of S.T.C."

To celebrate its seventy-fifth anniversary, Standard Telephones & Cables, Ltd., has produced a handsome brochure bearing the above title. It begins with the statement that "fundamentally, the story of S.T.C. is the story of the telephone" and the story starts with the opening of an office in Moorgate, London, by the late J. E. Kingsbury, on behalf of the Western Electric Co., in 1883. Much of the introductory matter relates to the activities of Kingsbury and his early associates.

The steady progress of the company and its successive developments in the telephone and allied fields are dealt with step by step. Of particular interest are the pictures of long-past equipment and events, such as those of the complicated array of wires surmounting one of the early telephone exchanges and the first demonstration of transatlantic radio-telephony.

It was in 1925 that the company assumed its present name and a new era of intensified development began. While the main interest was still equipment and cables for telephony, wired and radio, the company secured an eminent position in many other departments—power cables, control apparatus for numerous purposes, rectifiers, p.f. correction capacitors, etc. Emphasis is laid on the research carried out by the company and other aspects are touched upon. Altogether the book is a record of remarkable and versatile achievement.

Plessey German Company

The formation of a German company to further Plessey interests in the European market is announced by Plessey International, Ltd. Registered as Plessey Maschinen Elemente Gesellschaft m.b.H., with a nominal capital of D.M.200,000, the new company will be responsible for the manufacture of many products in the light engineering field, particularly those relating to hydraulic equipment. Production will be at Neuss, near Düsseldorf. The directors of the new company are Mr. B. G. W. Attwood, Mr. T. White Wilson, Mr. P. W. Faulkner, Mr. D. G. Booth and Mr. R. Sellies ("Geschaftsfuhrer").

Planned Lighting

With reference to the article on "Planned Lighting" in our issue of 24th April, Girdlestone & Co., Ltd., electrical engineers and contractors, of 23, Davies Street, London, W.1, inform us that while a number of the lighting fittings for the operating theatre at Dulwich Hospital were supplied by Troughton & Young (Lighting), Ltd., the actual installation was carried out by Girdlestone & Co., under contract to the South East Metropolitan Regional Hospital Board.

Veteran Electric Car "Retires"

A Krieger electric brougham built in Paris in about 1904 has now "retired" from service and has been placed in the road transport collection of the Science Museum, South Kensington. The brougham was for some time the town carriage of the Duke of Westminster and as recently as the

A Krieger electric brougham now in the road transport collection at the Science Museum

petrol shortage of two years ago provided a taxi service for the directors of the Chloride Electrical Storage Co., Ltd. Its two 40 V Exide-Ironclad batteries, having a capacity of 193 Ah, enabled the car to travel for more than 45 miles per charge. Capable of a top speed of 18-20 m.p.h., the car was driven by two compound four-pole Postal Vinay motors, working independently, each driving a front wheel through a simple pinion and fixed wheel with helical teeth. The controller was of the drum type, which gave seven forward speeds without the use of resistances, plus coasting, regenerative, reverse and emergency braking positions.

Public Speaking Finals

Twelve women and eleven men have won their way through to the national finals of the 1959 E.D.A. Public Speaking Competition, which will be held on 13th May (women) and 14th May (men), and they will attempt to win the competition's main awards—the Faraday Silver Challenge Shields. The present holders of the shields are the South of Scotland Electricity Board (women) and the London Electricity Board (men). The contests are to be held in the Connaught Rooms, Kingsway, London, W.C.2, and visitors are welcome. Competitors will commence to speak at 10.15 a.m. and the results will be known at about 3.30 p.m. on each day. This year's contestants, with their Boards shown in parentheses, are as follows:—

Women's Section: Miss H. Reeves (South Eastern), Miss J. Goodwin (Southern), Miss M. Young (South Western), Miss M. Giblin (Eastern), Miss V. Judge (East Midlands), Miss M. Higgs (South Wales), Miss J. Jones (Merseyside and North Wales), Miss A. Hunt (Yorkshire), Miss C. Glenross (South of Scotland) and the winners of the London, North Western and North of Scotland contests.

Men's Section: Messrs. C. Harris (Southern), P. Hinton (South Western), B. Ward (Eastern), R. Dilleigh (East Midlands), B. Draper (Midlands), E. Richardson (Merseyside and North Wales), M. Moorhouse (Yorkshire), J. Harmsworth (North Eastern), D. Mayes (South of Scotland) and the winners of the North Western and North of Scotland area contests.

Export Credit Insurance

Several developments in the facilities offered by the Export Credits Guarantee Department were announced at a Press conference in London last week by Mr. L. J. Menzies, secretary to the Department. A new scheme, he said, was being introduced shortly which would enable each of the E.C.G.D.'s 14 branch managers to agree, almost immediately, a figure on many of the buyers known to the department. At present a delay was caused by the need to refer to London, where the central records of 140,000 current buyers were housed.

Exporters of commodities, consumer goods, and production line engineering goods would in future have the option of covering their business on a three-year—against the present 12 months'—basis. Since E.C.G.D. would benefit by obtaining a greater spread of exporters' business, premium rebates of 5 per cent would be made to policy holders of three years' standing, and 2½ per cent to other exporters who took out three-year policies. An improved form of cover on stocks held overseas and new policies to cover the business of confirming houses and the construction industries were also being introduced. Emphasising the fact that benefits from developing E.C.G.D. business were passed straight back to the policy holder, Mr. Menzies stated that the revised rating schedules for short-term business introduced last November had resulted in an average reduction of premium of some 6 to 7 per cent.

In the year ended 31st March, 1959, the E.C.G.D. increased its reserves by some £2·6 million to £17·9 million and covered 16 per cent of all exports from this country, against 14 per cent in the previous year.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Monday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £233 5s 0d
Fire Refined 99·70%	ton £232 0s 0d
Fire Refined 99·50%	ton £231 0s 0d
COPPER Tubes ..	lb 2s 3½d
Sheet	ton £264 10s 0d
H.C. wire and strip ..	ton £284 15s 0d
LEAD, English ..	ton £69 5s 0d
Foreign	ton £68 0s 0d
MERCURY	flask £79 0s 0d
TIN, block (English) ..	ton £783 10s 0d
ZINC, G.O.B. Foreign	ton £74 5s 0d
BRASS Tubes (solid drawn)	lb 1s 10½d
Wire	lb 2s 7½d
PHOSPHOR BRONZE Wire	lb 4s 1d
PLATINUM	oz £28 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 29½d—30½d

Bowthorpe in New Zealand

Because of import difficulties Bowthorpe Holdings, Ltd., has decided to produce its overhead line fittings in New Zealand. For this purpose a new company, Bowthorpe (N.Z.), Ltd., has been formed, in conjunction with the Hamer Electric Co., Ltd., to operate a factory at Christchurch. It is hoped to begin production by next autumn.

Batti-Wallahs' Society

With the opening of the cricket season, the guest speaker at last week's luncheon of the Batti-Wallahs' Society was appropriately Mr. P. G. H. Fender, the former captain of Surrey County Cricket Club. In the heyday of his career, Mr. Fender was one of the personalities of English cricket, and he held many decided views on the game. In his talk last week he was concerned with the new l.b.w. rule and the attitude of the popular national Press to the game, both of which he contended were bad. and he put in a plea for the encouragement of young players rather than uninformed criticism.

Before lunch commenced, Mr. H. H. Spencer, the outgoing president, invested Mr. J. Temple Hazell, the new president, with his badge of office, and Mr. Temple Hazell, in return, presented Mr. Spencer with his past-president's badge. Later Mr. Temple Hazell also presented Mr. H. E. Fleetham, who succeeds him as assistant hon. secretary and treasurer, with his badge of office. Mr. T. C. F. Bigland (the "Mate") announced that the next luncheon would be on Thursday, 28th May, when the speaker would be Mr. W. C. Thorpe, line traffic manager, British Railways, Eastern Section.

Appointments Service for Engineers

Following discussions between the Council of the Engineers' Guild and the board of the Professional Engineers Appointments Bureau, it has been agreed between the two bodies that the functions of the Bureau shall be transferred to the Guild. An appointments division will be created in the Guild office to carry out these functions for corporate members, graduates and students of the Institutions of Civil, Mechanical, Electrical, and Chemical Engineers, and the present registrar and secretary of the Bureau, Mr. J. Muil, M.I.E.E., and assistant secretary, Mr. H. Bailey, are being invited to join the Guild secretariat as registrar and assistant registrar respectively of the new division. The work of the division will be controlled by a Professional Engineers Appointments Board, appointed by and responsible to the Council of the Guild. Final details of the transfer are still being discussed and a further statement will be made in due course including the names of the members of the profession who have been appointed to form the new Board. It is hoped that the arrangements described will take effect on 1st June, but the appointments division will continue to operate from the present address of the Bureau, 39, Victoria Street, London, S.W.1 (Abbey 1737), until further notice.

Trade Announcements

Mr. E. Wilson, sales and service representative of **Research & Control Instruments, Ltd.**, for Scotland, has removed to 35, Hilton Road, Bishopbriggs, nr. Glasgow (telephone: Bishopbriggs 2320).

The Glasgow branch office of **Dorman & Smith, Ltd.**, is now at 73, Robertson Street, Glasgow, C.2. The telephone number (Central 2479) remains unchanged.

Financial Section

STOCKS and SHARES

WITH activity and prices still running very strongly in the Stock Exchange, the industrial market has reached that stage in its upward course where interest tends to spread increasingly outwards from the traditional leaders into the ranks of the smaller and less well-known enterprises. On this occasion the impression is that the tendency derives extra momentum from the almost daily appearance of bids or merger propositions. In some recent cases where a minor firm has been invited into a major group, the terms have reacted upon the price of the former's shares so satisfactorily as to excite a good deal of research into the existence of similar possibilities elsewhere. Dealers in electrical shares think that some recent price movements might be associated to some extent with conjectures on such lines.

Rising Prices

Many gains have again been recorded in the electrical share lists. For the present the shares of the big groups, and especially of the heavy engineering firms in the nuclear power construction associations, are being left rather in the background, but in other sections many of the rises have been decidedly sharp. With the motor industry continuing to report a high rate of output, Lucas were marked up 4s, to 50s, and S. Smith 1s to 14s 3d. An advance of 5s, to 72s 6d, in International Computers ran parallel with the activity in Elliott-Automation. Electrical Components at 14s 3d and Walsall Conduits at 22s 3d were both 2s or more to the good, while gains of a shilling upwards raised Electric Construction to 31s 6d, Hackbridge Holdings to 16s 9d, Hackbridge & Hewittic to 16s 3d, Reliance Clifton to 19s 3d, Southern Areas to 13s, Ward & Goldstone to 42s and Vactric to 40s. Among lower-priced shares there were useful improvements in Bulpitts, Dubilier, Dictograph and a number of others.

Elliott-Automation

Quoted at under 20s a little over a month ago, and later at 23s 9d after the announcement of the annual results, Elliott-Automation 5s shares were raced up to 30s within the course of a few days, subsequently reacting to 28s 6d. Fundamentally the popularity of the shares is, of course, attributed to optimism about the future of firms in the lead of automation developments. The spectacular behaviour of the price in the last week or two is cited, however, as an example of what sometimes happens as a sequel to the concentration of American interest on individual United Kingdom equities, for it coincided with reports that facilities have now been created for dealing in the shares on Wall Street. On the basis of the recently declared 10 per cent dividend the yield on the shares is down to no more than 1¾ per cent, which again is much more in line with present American standards than with our own.

Parsons and Reyrolle

In his statement accompanying the full annual report, the chairman of

Price Changes in

Company or Board	Nom. Value	Middle price 4th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 High-est	1959 Low-est
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	78½		3	3	3 16 6	80½	77½
Brit. Elec. 1974/77	100	75½		3	3	3 19 6	77	74½
Brit. Elec. 1976/79	100	79		3½	3½	4 8 6	80½	77½
Brit. Elec. 1974/79	100	89		4½	4½	4 15 6	90½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	19/6	+1/-	6·8†	7†	12 9 9	19/6	16/-
East African Power	£1	20/-		7½	8	8 0 0	22/3	19/3
Nigerian Elec.	£1	14/6		10	10	13 16 0	15/-	13/9
Perak Hydro-Elec.	£1	14/-	+6d	12½	10	14 5 6	14/6	12/3
Electrical Shares								
Aberdare Holdings	5/-	16/-		17½	17½	5 9 6	16/3	15/6
Aerialite	1/-	8/9	−3d	51½	54	6 3 6	9/6	7/9
Allen, W. H.	£1	45/6		10	11	4 17 9	45/6	43/-
Anglo-Portuguese Tel.	£1	28/9	+6d	8	9	6 5 3	29/3	26/6
Aron Elec. Ord.	£1	57/6		15	15	5 4 3	61/6	57/6
Assoc. Elec. Ord.	£1	60/-	−1/3	15	15	5 0 0	61/3	53/9
Automatic Tel. & El.	£1	82/6	+6d	17	17	4 2 6	82/6	77/6
Babcock & Wilcox	£1	48/-x.d.		13½	13	5 8 3	53/9	45/6
Bakelite	10/-	27/-	+3d	15	15	5 11 0	27/6	22/-
Baldwin, H. J.	2/-	3/6	+1/-	20	20	—	3/-	2/3
Berry's Electric	5/-	16/-	+6d	10	10	3 2 6	15/9	10/9
Bowthorpe Holdings	2/-	15/3	−3d	37½	25*	3 5 6	15/6	11/9
British Elec. Traction: Def. Ord. "A"	5/-	39/6	+6d	25	25	3 3 3	40/-	35/6
B.I. Callender's	£1	56/3x.d.	+1/-	12½	13½	4 16 0	56/6	44/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	20/6	19/9
British Thermostat	5/-	42/6		25	30	3 10 6	42/6	37/-
British Vac. Cleaner	5/-	7/9		10	7½*	4 16 9	7/9	4/6
Brook Motors	10/-	54/3	+6d	25	24½*	4 9 3	54/3	46/-
Bulgin, A. F.	1/-	8/9		45	50	5 14 3	9/3	6/9
Bulpitts	5/-	13/9x.d.	+6d	—	15	5 9 0	13/9	10/-
Burco Dean	5/-	13/9	+3d	22½	16*	5 16 3	13/9	12/3
Cable & Wireless: Ord.	5/-	14/9		10	10*	3 7 9	14/9	12/3
4% Loan	100	94½		4	4	4 4 9	95	93
Chloride El. Storage "A"	£1	78/-x.d.	+9d	17½	20‡	5 1 6	79/6	65/6
Clarke Chapman	£1	55/9	−1/3	27½	13‡*	4 18 9	66/3	55/9
Cole, E. K.	5/-	17/6		17½	17½	5 0 0	21/3	17/3
Contactor Switchgear	5/-	14/-x.d.	+1/-	20	14*	5 0 0	14/-	12/-
Cossor, A. C.	5/-	8/3	−3d	2½	Nil	Nil	9/-	6/3
Crabtree	10/-	30/9	−3d	20	20	6 10 0	31/6	28/-
Crompton Parkinson	5/-	14/3		16	12*	4 4 3	14/3	11/9
Davis & Timmins	5/-	15/-x.d.		18	20	6 13 3	15/3	14/6
De La Rue	10/-	35/6	+6d	35	17½*	4 18 6	35/6	30/3
Decca "A"	10/-	33/3	−6d	43½	50	6 0 3*	40/3	33/3
Desoutter	5/-	26/6	−3d	32½	21½*‡	4 1 6	26/9	19/-
Dewhurst	2/-	7/6		20	20	5 6 9	8/3	7/3
Dictograph Tel.	2/-	8/3	+6d	20	20	4 17 0	8/3	7/-
Dubilier Condenser	1/-	4/6	+9d	30	20*	4 9 0	4/6	3/3
Duport	5/-	11/9	+6d	25	12½*	5 6 6	11/3	10/3
E.M.I.	10/-	55/-		15	20*‡	3 12 9	64/6	50/-
Electrical Apparatus	5/-	13/6		12½	14½	5 2 6	14/-	13/-
Electrical Components	5/-	14/3	+2/9	12½	12½	4 7 9	14/3	10/6
Elec. Construction	£1	31/6	+1/6	8½	8½	5 8 0	31/6	27/9
Elliott-Automation	5/-	28/9	+5/-	—	10	1 14 9	30/6	16/9
Enfield Cable Ord.	£1	20/9	+1/-	2½	Nil	—	22/3	16/3
English Electric	£1	63/9		14	14	4 7 9	65/6	56/9
English Electric 3½% Pref.	£1	12/6		3½	3½	6 0 0	12/9	12/3
Ericsson Tel.	5/-	23/3		12†	13†	4 17 6	27/3	25/9
Ever Ready	5/-	28/-		37½	20*	3 11 6	28/-	22/-
Falk Stadelmann	£1	28/-	+6d	17½	10*‡	7 2 9	32/9	26/3

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

C. A. Parsons referred to a further increase in output and ascribed the contraction of trading profits largely to decreasing margins of profit and higher research costs. In A. Reyrolle's annual report turnover was said also to have risen to a record high level, and this enabled the company almost to maintain its trading profits despite the severity of price competition. In each case, lower tax provisions leave a moderate increase in the year's net surplus, and the greater part of the latter is retained as usual in the businesses: Reyrolle's 17½ per cent dividend (as before) is covered practically three times by available earnings, and there is more than fourfold cover for the payment of 8¼ per cent (including an extra five-eighths per cent) paid by Parsons. Share prices have declined over the past month to 86s 3d for Reyrolle and 46s for Parsons.

Electrical Investments

Company or Board	Nom. Value	Middle price 4th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1959 Highest	1959 Lowest
Electrical Shares—continued								
G.E.C.	£1	32/-		12½	10	6 5 0	40/3	31/3
G.E.C. 6½% Pref.	£1	21/-		6½	6½	6 3 9	21/6	20/3
General Cables	5/-	8/9		24	15	8 11 6	9/-	7/6
Greenwood & Batley	£1	83/-		17½	20	4 16 6	83/9	75/-
Hackbridge Holdings	5/-	16/9	+1/6	20	20	5 19 6	16/9	14/3
Hackbridge & Hewittic	5/-	16/3	+1/9	20	20	6 3 0	16/3	13/9
Head Wrightson	5/-	26/3	−6d	22½	17½*	3 6 9	28/6	24/3
Heatrae	2/-	9/-		15	20	4 9 0	9/-	7/6
Holophane	5/-	15/6		37½	22½*	7 5 3	16/6	15/6
Hoover	5/-	66/-	+2/6	50	60	4 11 0	66/-	55/-
I.C.I.	£1	34/6		12	8*	4 12 9	38/3	33/-
Intl. Combustion	5/-	36/6	+3d	25	30‡	4 2 3	36/6	29/9
Intl. Computers & T.	£1	72/6	+5/-	—	8‡	2 4 3	72/6	57/6
Johnson & Phillips	£1	27/6	+6d	10	5	3 12 9	30/6	22/-
Lancashire Dynamo	£1	57/6x.d.	+9d	11	12½‡	4 7 0	57/6	42/-
Laurence Scott	5/-	17/3x.d.		15	15	4 7 0	17/9	16/6
Lister, R. A.	£1	39/3	+9d	10	12½	6 7 6	41/-	32/9
Lucas, J.	£1	50/-	+4/-	7½	10‡	4 0 0	50/-	43/3
Marconi Marine	£1	40/-	+6d	10	10	5 0 0	48/6	40/6
Marryat & Scott	2/-	9/6		35	37½	3 19 0*	9/6	8/6
Mather & Platt	£1	47/-		15	10‡*	4 10 9	51/6	41/3
Metal Industries	£1	47/6	+3/-	9	14	5 18 0	47/6	39/9
Midland Elec. Mfg.	£1	44/6	−6d	12½	10*	4 10 0	45/-	41/6
Morphy-Richards	4/-	22/6		20	20	3 11 0	22/6	18/-
Murex	£1	47/6		20	17½	7 7 3	49/6	42/-
Newman Ind.	2/-	2/9x.d.		10	10	7 5 6	2/9	2/3
Oldham & Son	1/-	3/-		17½	17½	5 16 9	3/-	2/6
Parsons, C. A.	£1	46/-x.d.	−2/3	7½	8¼	3 10 0	55/9	46/-
Philips' Lamps	Fl.10	112/6		14	14	2 7 3	116/-	88/-
Plessey	10/-	92/-	+5/-	30	30	3 5 3	92/-	70/6
Pye	5/-	14/9	+6d	12½	12½	4 4 9	16/9	13/9
Pyrotenax	5/-	35/6	+6d	—	27½‡	3 17 6	38/3	33/9
Reliance Clifton	5/-	19/3	+1/3	13½	15	3 18 0	19/9	17/6
Reyrolle	£1	86/3	−1/3	17½	17½	4 1 3	98/-	86/3
Rheostatic	4/-	9/6		12½	12½	5 5 3	9/6	8/3
Richardsons Westgarth	10/-	13/9	−6d	16¾	8¼*	6 1 3	15/3	13/9
Scottish Cables	4/-	14/9		27½	27½	4 7 0*	16/3	13/3
Simon-Carves	5/-	31/3	+6d	25	25	4 0 0	32/-	28/6
Smith (England), S.	4/-	14/3	+1/-	20	12½*‡	3 10 3	14/3	11/6
Southern Areas	£1	13/-	+1/-	7½	Nil	Nil	14/9	10/6
Strand Elec.	5/-	10/3		15	15	7 6 3	10/3	8/6
Sturtevant	5/-	18/6	+3d	15†	15†	7 1 0	19/-	17/-
Sun Elec.	£1	80/6		25	25	6 4 3	80/-	66/-
Switchgear & Cowans	5/-	12/3		22½	15*	6 2 6	13/-	10/3
Taylor Tunnicliff	5/-	21/9	−1/-	17½	17½	4 0 6	26/-	18/-
T.C.C.	10/-	43/9		25	25	5 14 3	43/9	38/-
Telephone Mfg.	5/-	5/9		10	10	8 14 0	5/9	4/9
Telephone Rentals	5/-	14/3	+9d	12½	12½*	4 7 9	14/3	11/9
Thompson (John)	5/-	24/6	+3d	25	25	5 2 0	25/6	22/9
Thorn Elec.	5/-	37/-	+9d	17½	17½	2 7 3	38/6	26/3
Thornycroft	£1	25/9	+2/-	12½	7½	5 16 6	25/9	20/6
Tube Investments	£1	85/-	+1/3	15	17½	4 2 3	85/3	71/6
Vactric	5/-	40/-	+1/3	25	25	3 2 6	44/6	26/3
Veritys	5/-	2/6		12½	2½	—	5/-	1/3
Walsall Conduits	4/-	22/3	+2/3	20	22½	4 1 0	22/3	16/9
Ward & Goldstone	5/-	42/-	+1/6	40	25*	2 19 6	42/-	30/6
Watford	2/-	9/-		25	25*	5 11 0	9/-	7/6
Westinghouse	£1	43/9		10	10	4 11 6	47/-	39/6
West, Allen	5/-	12/9		12½	11¼*	4 12 6	14/-	11/9
Wolf Electric	5/-	7/9		10	10	6 9 0	8/6	7/9

Plessey Capital

Having been marked up by a further 5s, to 92s, Plessey 10s shares show a net gain of 13s 9d since the announcement of the company's proposal to distribute a two-for-one scrip issue, and of their intention to make a further offer of shares for cash in the reasonably near future. In that connection it is interesting to note, in view of some recent happenings, that the directors make a point of assuring shareholders that there is no intention of making an issue in any size or form affecting the control of the business without their previous sanction. Regarding dividend prospects, the directors forecast an interim payment of 18 per cent on the existing capital in June, when the current financial year ends. The new shares will rank for the final payment due in December. For the past three years, interim dividends of 15 per cent have been followed by final payments at the same rate.

A. C. Cossor

The financial year of A. C. Cossor ended in March, and although the results will not be due until the late summer the 5s shares have become a good deal firmer, on balance, since the interim statement issued last month. Emphasis was placed by the directors upon the advantages resulting from the sale to Philips Electrical of the radio and television subsidiary, whose losses had been submerging the satisfactory earnings of other members of the group. Profits from the latter in 1958–59 were estimated to provide amply for the payment of the preference dividends, and consideration of an ordinary distribution would await completion of the accounts. The last dividend was one of 2½ per cent for 1956–57.

Company News

Telephone Rentals report a 40 per cent expansion of net earnings in 1958 and, as forecast at the time of the one-for-five scrip issue, are maintaining the dividend at 12½ per cent on the increased capital. The shares moved up 9d to 14s 3d. Allotment letters were due to go out today (Friday) in connection with R. B. Pullin's issue of 1·78 million new 2s ordinary shares at the price of 7s 3d. With the old shares previously quoted at 12s 6d, "cum-rights," a premium of about 1s 6d on the new is indicated. It is the company's intention to pay for the current year a second interim dividend of 5 per cent, applicable only to the older capital, followed by a 20 per cent final on both old and new shares.

REPORTS and DIVIDENDS

C. A. Parsons & Co., Ltd.—The annual meeting will be held on 20th May. In his review of 1958, which has been circulated, Mr. F. W. Gardner (chairman) says that the sales turnover, including contracts completed during the year, was slightly more than that of the previous year. Profit margins, however, have been decreasing and in addition the cost of research, particularly in the nuclear field, is rising. The works have operated at full capacity during the year and the orders in hand will keep them fully employed for some time ahead. The volume of orders received last year was below the record totals of preceding years but was satisfactory having regard to the difficult conditions under which the company now operates. There has been no increased demand for plant required for power stations in this country, and this, together with the general increase in the size of individual units, has resulted in an appreciable reduction in the number of contracts placed. Given a period of stability in labour and material costs, they expect to maintain a satisfactory order book. The consumption of electricity continues to increase everywhere and they can look forward to a continued demand for generating plant which should gain impetus as better facilities for financing capital projects become available.

The most important of the orders placed with the company during the year was that for the 550 MW unit to be installed at Thorpe Marsh power station, while earlier in the current year the Tennessee Valley Authority had advised them of its intention to place an order with the company for a 500 MW unit to be installed at Colbert station. Referring to the Calder Hall and Chapelcross nuclear generating stations, the chairman says that altogether for these two stations the company is supplying 16 turbo-generators and 32 gas circulators together with the condensing plant, ductwork and other equipment. The output of power transformers during the year under review was the highest yet recorded by the Transformer Division.

Dealing with the works extensions, Mr. Gardner refers to the new shops at Heaton South West, where the installation of machine tools and other equipment was approaching completion at the end of the year, and an extension of an erecting bay, which will be completed in the near future. Work was commenced during the year on an extension of the Fabricating Department at the Walkergate Works, and a further addition to the fabricating capacity is being carried out at Longbenton. A new aerodynamics laboratory at the Heaton Works is in course of construction.

Referring to the construction of the nuclear power station at Latina, Italy, by the Nuclear Power Plant Co., he says that C. A. Parsons are to supply the turbo-generators, the gas circulators and other equipment. Much progress has been made at Bradwell nuclear power station. The construction of the Nuclear Research Centre adjacent to the Heaton Works has proceeded according to programme and all the research groups who have been working in other laboratories have been transferred to the new building. This Centre will make a considerable contribution to nuclear science and engineering generally. The Anglo Great Lakes Corporation factory at Newburn commenced producing nuclear graphite last June, and the whole of the output is being sold to the United Kingdom Atomic Energy Authority. Production of commercial quality graphite for industrial use is planned to commence in the course of the next few weeks.

Turning to the subsidiary companies, Mr. Gardner says that Sir Howard Grubb, Parsons & Co., Ltd., continue to be fully occupied, the Whyalla plant of C. A. Parsons of Australia has continued to have a satisfactory level of employment, and has had a profitable year, as have also the subsidiaries in Canada, South Africa and Rhodesia.

The British Aluminium Co., Ltd.—The annual meeting will be held on 26th May. In his circulated statement, Sir Ivan Stedeford (chairman) refers to the changes on the board following the events which led to the company's becoming a subsidiary of Tube Investments, Ltd. He says that he took over the chairmanship as a temporary arrangement and as the position requires considerably more time than he can give, Lord Plowden has consented to join the board as chairman from the beginning of 1960.

The year 1958 was generally a difficult one for the aluminium industry. Competition intensified as demand weakened during a period when new and additional capacity was coming into production. The impact of these conditions was particularly severe in export markets, where orders fell away sharply and prices too often were only marginally attractive. These adverse conditions were responsible for the decline in trading profits. Referring to the payment of an ordinary dividend of 17½ per cent for the year, an increase over last year of 5½ per cent, Sir Ivan says that this absorbs the whole of the year's available trading profits and is unjustified. The payment has been made for this year only, to conform with the conditional undertaking given by the board last December in respect of this dividend. Dividends paid for the current and subsequent years will be in accord with a sound financial and dividend policy based on ascertained results, and in his opinion, it is highly improbable that a dividend at this rate can be repeated for the current period.

The managing director, in his statement, says that the alumina plants in the United Kingdom were maintained in full production largely through overseas demand, but the output of the reduction plants in Scotland was seriously curtailed by shortage of power. Rainfall over the watershed areas of their hydro-electric power stations was well below average. The resulting loss of output, combined with the reduction in the price of the metal, materially affected the profits in 1958. The volume of output from the rolling mills and extrusion plants was again somewhat lower than in the preceding year. The statement refers to the progress of the subsidiary, overseas and allied companies.

Bakelite, Ltd.—In the course of his speech at the annual meeting held on 30th April, Mr. S. Adams (chairman) said that the total sales during the year under review, both by weight and value, were higher than in any previous year. The marketing of Bakelite polyethylene manufactured by Union Carbide, Ltd., had been most successful. A noteworthy increase in the volume of sales of p.v.c. products was effected, but a highly competitive situation arose during the year, mainly due to imports into this country of low price Japanese resin. The use by the radio, television and electronic industries of their copper clad laminated sheet for printed circuits increased considerably during the year and in spite of increased competition they maintained their position in the forefront of suppliers of laminated industrial sheet. The demand for "Warerite" decorative laminates continued to grow.

Overseas trade in 1958 showed considerable improvement on the previous year, but because of the strong competitive conditions the profits derived, while higher than 1957, were not commensurate with the increase in sales. Both their subsidiary and associated companies in India enjoyed a successful trading year.

Sales for the first four months of the current year showed an increase over the same period of last year.

T. Clarke & Co., Ltd., report net profits for 1958 of £45,133 (after providing £45,236 for taxation) as compared with £36,635 for 1957. The dividend for the year is maintained at 16 per cent by a final payment of 8 per cent and it is proposed to make a one-for-three scrip issue.

Enfield Rolling Mills, Ltd.—The annual meeting of the company was held yesterday (Thursday), the Earl of Verulam (chairman) presiding. In his statement, which had been previously circulated, the chairman said, in referring to the Brimsdown factories, that it was a good year for the Enfield Copper Refining Co., Ltd., and the Electrodes Department had a better year than 1957. In the rod

mill the depressed home demand for the cable industry was offset by very heavy exports, and the year was an excellent one; such extensive business overseas, however, was unlikely to recur. The drawing mill and the sheet mill also had a good year. London Zinc Mills, Ltd., achieved some substantial exports and Enfield Rolling Mills (Aluminium), Ltd., was successful both in the refining and fabrication works. After referring to the progress at the other factories, the chairman said that the tonnage of copper handled during the year set a new record. The service departments had had a very heavy year's work.

With regard to the prospects, they expected that the current year would show a substantially lower profit than for 1958 in the rod mill. Copper export business was changing rapidly, to the detriment of the exports of rods or wire, and the current reconstructions and amalgamations in the electric cable industry meant that several customers who had for many years bought rods from Enfield Rolling Mills were now part of one or other of two major self-sufficient groups that had been formed. Other developments in the structure of the cable industry seemed inevitable.

Aberdare Holdings, Ltd. — The annual meeting was held on Monday last, Sir John Pascoe (chairman) presiding. In his review of the past year, which had previously been circulated, the chairman said that the maintenance of the dividend at 17½ per cent over the past five years had meant that the group had increased its ability to withstand the greater competition which they were expecting in certain fields, and to take immediate advantage of the general revival in trade as the country climbed out of the slight recession of the past year.

Dealing with the various companies in the group, the chairman said, in referring to Aberdare Cables, Ltd., that their manufacturing experience during the year was much as he forecast in his last review and during the past six months the turnover had been well maintained. Although he was not quite so confident about the coming six months, nevertheless, with the extended range of the cable manufactured, he felt that they had every hope of maintaining their share of the business placed. A satisfactory level of output was achieved by Aberdare Engineering, Ltd. The profit level of the Ivor Power Speciality Co., Ltd., was maintained, but the reduction in the demand for power station equipment might militate against them in the years ahead; the present order book was reasonably satisfactory. The turnover of the Neckar Water Softener Co., Ltd., was rather better than for the previous period and prospects for the current year were satisfactory. The rate of increase of the turnover of South Wales Switchgear, Ltd., had been well maintained and plans were now well advanced for expansion of the facilities at Pontllanfraith, a gratifying feature of the increased turnover being the amount obtained for export. With the capital expenditure they had in view for this company, they looked for increased expansion of its activities over the years.

The Anglo-Portuguese Telephone Co., Ltd., reports a gross revenue for 1958 of £3,098,118, as compared with £2,833,522 for 1957, and the net profit rose from £552,832 to £599,240. It is proposed to pay a final dividend of 6 per cent on increased capital, maintaining the dividend for the year at 9 per cent. General reserve receives £250,000 and the balance carried forward is raised by £12,550 to £261,862.

Tube Investments, Ltd., has declared an interim dividend of 7½ per cent (unchanged) on increased capital.

Radio Rentals, Ltd., is paying an interim dividend of 7½ per cent (against 10 per cent) on increased capital.

Aerialite, Ltd., has announced an interim dividend of 20 per cent (unchanged).

Eveready South Africa, Ltd., is paying an interim dividend of 5 per cent (against 10 per cent) on doubled capital.

New Companies

L.G.M. Manufacturing Co., Ltd.—Registered 20th April. Capital £1,000. To acquire the business of L.G.M. Manufacturing at Walsall, carried on by L. G. Hill, Mary C. Moorehead, and G. T. Green and to carry on the business of manufacturers and distributors, of electrically heated carpets, underfelts, rugs, pillows and blankets, etc. Directors: L. G. Hill, Mary C. Moorehead and G. T. Green. Regd. office: 18a, Hart Street, Walsall, Staffs.

Boardman Transformers, Ltd.—Registered 3rd April. Capital £2,000. To acquire the business carried on by R. Boardman at Manchester; to manufacture, service and generally deal in electrical transformers, etc. Directors: R. Boardman and Mrs. Dorothy Boardman. Regd. office: 34, Mary Street, Harpurhey, Manchester.

Smye-Rumsby, Ltd.—Registered 31st March. Capital £1,000. To acquire the business of B. A. A. Smye-Rumsby carried on at Dover, Folkestone and Deal, and to carry on the business of manufacturers, repairers, servicers and hirers out of and wholesale and retail dealers in radio, electrical and mechanical apparatus, etc. Directors: B. A. A. Smye-Rumsby and J. B. Smye-Rumsby. Regd. office: 2, Queen Street, Dover.

Increases of Capital

Plastic Insulated Cables, Ltd.—Increased by £20,000 in £1 6 per cent participating cumulative preference shares, beyond the registered capital of £10,000.

Dowding & Mills, Ltd.—Increased by £125,000 in 1s shares, beyond the registered capital of £75,000.

Liquidations

Hunt, Blackman & Co., Ltd., hydraulic, electrical and general engineers, 24, Newport Street, Lambeth, London, S.E.11.—Winding up voluntarily. Liquidator, Mr. L. P. Gibbs, 781, Salisbury House, London Wall, London, E.C.2, appointed 22nd April. Particulars of claims to the liquidator by 31st May.

Liss Accumulators, Ltd., battery manufacturers, Crown Works, Pallion, Sunderland.—Winding up voluntarily. Liquidator, Mr. J. H. Lundy, Midland Bank Chambers, Sunderland, appointed 9th April.

Veritys, Ltd.—Particulars of claims by 15th May to the liquidator, Mr. W. G. A. Russell, Lombard House, Great Charles Street, Birmingham, 3.

Bankruptcies

Teleradio Maintenance (London) Service, 22, Valleyside Parade, Eaton Mead, Chingford, London, E.4, electrical engineers.—Receiving order made 20th April on a creditor's petition. First meeting today (Friday) at 58-61, York Terrace, Regent's Park, London, N.W.1. Public examination 22nd June at the Court House, Upper Edmonton, London, N.18.

G. H. Collins, 20, Police Street, Brighouse, Yorks., lately carrying on business at Astoria Buildings, Brighouse, electrical engineer.—Last day for receiving proofs for dividend 9th May. Trustee, Mr. J. L. Williams, 20, North Parade, Bradford, Official Receiver.

D. Gillon, 52, Raynel Drive, Adel, Leeds, plumber and electrician.—Last day for receiving proofs for dividend 11th May. Trustee, Mr. J. L. Williams, Pearl Chambers, East Parade, Leeds, 1, Official Receiver.

R. R. S. Richards, 4, Mount Street, Wrexham, Denbighshire, electrical and radio engineer.—Receiving order made 23rd April on debtor's own petition.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 22nd May:—

Samson (design). No. 772,877. Class 9. Scientific, electric and electronic apparatus and instruments; optical, weighing, measuring, signalling, radar, and checking (supervision) apparatus and instruments; and parts.—Samson Apparatebau Akt.-Ges., Frankfurt/Main, Germany. Address for service, c/o Reddie & Grose, 6, Breams Buildings, London, E.C.4.

Brayhead. No. B782,432. Class 9. Radio, cinematographic and television apparatus; radio-gramophones; and electric and electronic instruments and domestic electrical appliances, and parts. **Brayhead.** No. B782,433. Class 11. Installations and apparatus for lighting, heating, cooking and refrigerating; installations and apparatus for sterilising and for de-icing purposes; and parts, all being electrical goods.—Brayhead (Ascot), Ltd., Full View Works, Kennel Ride, Ascot, Berks.

Graviner. No. 782,302. Class 9. Scientific and electrical apparatus and instruments; alarms; and apparatus and instruments automatically operated by the force of inertia or by impact for controlling the operation of electrical contacts; and parts.—Graviner Manufacturing Co., Ltd., 29, St. James's Street, St. James's, London, S.W.1.

Trimpot Jnr. No. 783,517. Class 9. Electric potentiometers and variable electric resistances.—Bourns Laboratories, Inc., Riverside, Cal., U.S.A. Address for service, c/o R. F. Cowling & Co., Bank Chambers, 329, High Holborn, London, W.C.1.

Casino. No. 784,759. Class 11. Heating apparatus, heating installations, and parts.—Simplex Electric Co., Ltd., Broadwell, Oldbury, near Birmingham.

Melesco. No. 785,192. Class 11. Furnaces (not for experimental purposes), boilers (not parts of machines), shaped linings for fireboxes, oil burners, heat regenerators, reheating installations, ovens for use in tempering, boiler tubes, installations for cooling superheated steam; and installations for heating or steam generating, and parts.—Superheater Co., Ltd., 97, Tottenham Court Road, London, W.1.

Horizon. No. 786,436. Class 11. Electric lighting fittings.—Revo Electric Co., Ltd., Britannia Works, Groveland Road, Tividale, Tipton, Staffs.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

CURRENT transformers in protection and automatic control circuits are particularly important during transient periods, when the currents are higher than the rated values. However, the transformation errors are then considerably greater than in steady operation and this has to be considered in the design of the systems served by the current transformers. Although there are hints in the literature that the partial magnetisation curves must be considered in the calculation of the transformers for transient conditions, no method is given of carrying this calculation out.

Four very useful rules were given in this respect by Madelung in 1905. They can be made slightly more accurate, although only the fourth rule requires modification, since the first three are exact. For practical calculations a set of partial curves, as symmetrical loops and return curves, drawn to different scales, are required. Calculations of the transient processes based on the complete magnetisation curve lead to considerable errors. The magnitude of the magnetising current in transient conditions is strongly affected by the residual inductance of the core, and the value and character of the load impedance of the secondary circuit. — "Calculating Transient Processes in Current Transformers from Partial Magnetisation Curves," I. M. Sirota, *Elektrichestvo*, No. 2, pp. 21-26, 1959, in Russian.

Power Factor Improvement

The VAr consumption of a grid controlled mercury arc rectifier installation is analysed and various methods of supplying VAr are considered and experimentally investigated. In particular, a new method of single-stage forced (direct) commutation is presented and its mode of operation is described and discussed. Generally, all the methods described lead to an increased output and reduced voltage drops and losses on both a.c. and d.c. sides of the plant. However, the new method differs from compensating capacitor banks on the three-phase side, whose VAr are independent of the loading, by the fact that the VAr increase with increasing load, so that the rectifier plant has actually a favourable compounded external characteristic.

It is admitted that the idealisations introduced in the theoretical analysis yield generally too optimistic a picture of the actual p.f. achieved. The interphase transformer requires a rating of 15 to 20 per cent of the rating of the corresponding rectifier transformer. In the new circuit presented the rectifier will work steadily at any phase angle, but preferably at leading p.f. between 1 and 0·9 when the loads vary, and at 0·9 to 0·85 with constant loading. This reduces the voltage variations in the a.c. supply to the minimum. The investment for the auxiliaries required can be written off in one or two years in installations with variable loads (traction substations, etc.) and within one year in constant-load installations (electrolytic and metallurgical plants).— "Improvement of the Power Factor of Electric Installations with Mercury Rectifiers," S. Jira, *Elektrotech. Obzor*, Vol. 47, No. 12, pp. 630-636, December, 1958, in Czech.

Contact Rectifier Transformers

An analysis of the time relation of the flux linkages of the commutating circuit yields the expression of the rectified voltage on no-load and under load. This expression is used to derive the equation of the secondary voltage of the transformer, by which the effects of the following parameters on the supply voltage are determined: the air inductance of the interphase transformer and the quality of its core material as well as its main turns number; the inductance of the busbars of the commutating circuit; the short-circuit voltage of the transformer and the power on short circuit of the whole system; and the efficiency, circuit connections, control angle and load of the rectifier.

These parameters can all be determined in a way showing their optimum working range and limiting values. In addition, a graphical and analytical method is presented for determining the supply voltage from the regulating characteristic of the plant. This is a relatively simple nomogram, which is also suitable for determining the most appropriate tappings of the transformer when given loads are to be served by the rectifier. The method is illustrated by an example of an industrial d.c. supply.— "Calculation of the Voltage of the Rectifier Transformer Supplying a Contact Rectifier," Z. Kresadlo, *Elektrotech. Obzor*, Vol. 47, No. 12, pp. 619-626, December, 1958, in Czech.

Air-Blast Circuit-Breakers

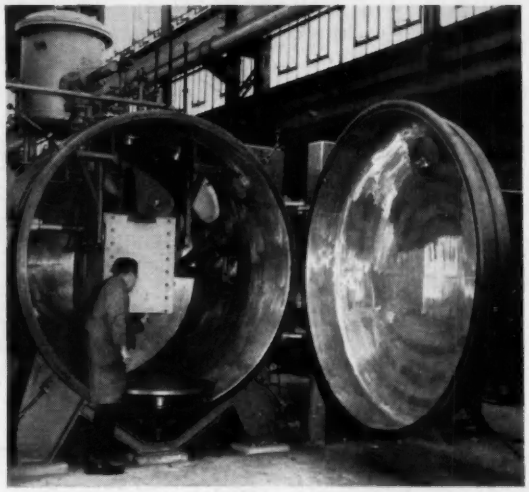
The dielectric strength of flowing air is lower than that of still air. This is due to the formation of regions of considerably lower than average gas-dynamical pressures in the air flow. These facts apply to the air in the break of a quenching chamber and are considered by distinguishing between the "local" dielectric strength of the gap and the integral value of dielectric strength. Although the latter determines the effectiveness of the quenching chamber, it is essentially co-determined by the local strength in the gap. The improvement of the quality of the gap between the contacts must be based on increasing the integral as well as the local dielectric strength.

A contact system with one hollow and one solid contact is, under otherwise equal conditions, superior to a system with two hollow contacts, but the conditions of the latter can be considerably improved by partially closing one of the hollow contacts. This method particularly improves the breaking capacity of circuit-breakers with two hollow contacts and reduces the voltage surges on disconnecting long lines on no-load. So far, it does not appear that the different values of the dielectric strength of moving and still air have been considered in the design of air-blast circuit-breakers. A good deal of further investigation is required before appreciable improvement in the breaking capacity of air-blast breakers can be expected.— "The Electrical Characteristics of the Compressed Air in Air-Blast Circuit-Breakers," E. M. Tseirov, *Elektrichestvo*, No. 12, pp. 1-9, 1958, in Russian.

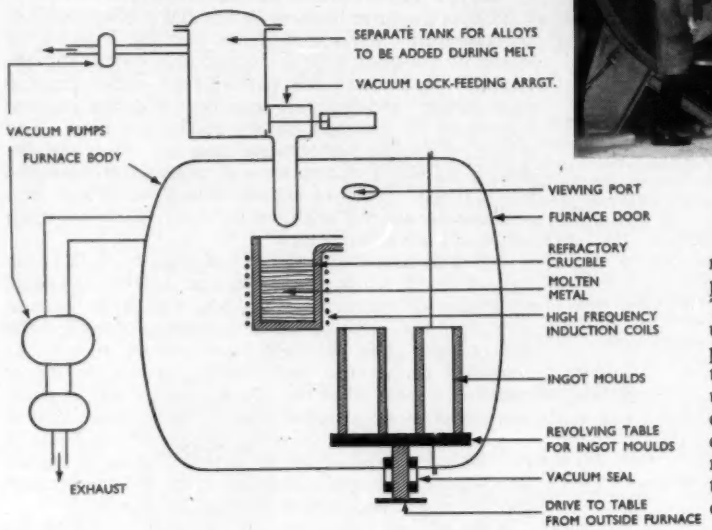
Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

VACUUM-MELTED METALS

A TECHNIQUE FOR PROCESSING NEW ALLOYS



Wild Barfield/N.R.C. h.f. vacuum induction melting furnace



INTENSIVE research by Jessop-Saville, Ltd., into the development of new alloys and new metals has led to the introduction of new processing techniques, one of the more outstanding being that of melting in vacuum. This process facilitates the study and production of a new range of metals and alloys which must be melted in the absence of air. Particular examples of these metals are titanium and zirconium. It was, however, found that the vacuum melting process would also considerably improve the characteristics of many existing steels and in fact permit the production of new alloy steels which could not be made by any other method.

The two methods adopted by Jessops for vacuum melting were the consumable electrode arc melting process and the high-frequency induction melting process. The new "Heraeus" consumable arc melting furnace which has now been installed is capable of melting titanium ingots up to 24in in diameter and in excess of 2½ tons in weight. Also recently installed is a new 600 lb Wild Barfield/N.R.C. h.f. induction melting furnace. These furnaces are of the largest type in this country and in combination provide the largest operational vacuum melting plant outside America.

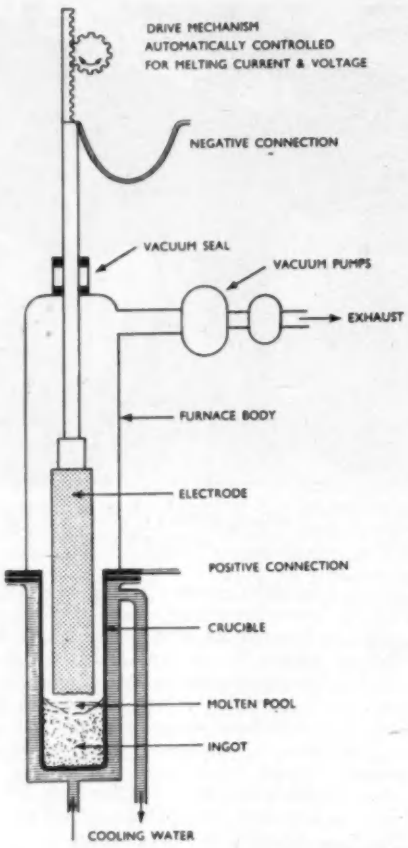
Vacuum melting ensures virtual freedom from non-metallic inclusions. In ball bearing and ball race steels it is particularly important that there shall be no metallic inclusions which might cause premature failure. Vacuum melting also reduces the total gas content of the metal. Tests have shown that with air-melted steel, remelting in vacuum reduces the total oxygen, hydrogen and nitrogen content of the steel from 600 parts per million to 200 parts per million. This feature of the process is particularly useful in the production of stock for precision castings or for remelting prior to precision casting, for in this way the undesirable blow-holes and gas pockets can be obviated. The production of certain steels with low hydrogen content minimises the need for long immunisation heat treatments to guard against the danger of hair line cracking.

Induction vacuum melting has made possible the production of alloys which, because they contained elements which readily oxidised, could not be produced by conventional air-melting methods. With this new technique the development of high-temperature materials is possible. One such alloy, Jessop G.64, contains a high percentage of aluminium and titanium and can be made satisfactorily only in a vacuum melting furnace. It has excellent high-temperature properties and is being assessed for stator and turbine blade applications.

The advent of nuclear power plants has posed further problems for the metallurgist in the demand for new materials. One of these is zirconium, which can be produced only by vacuum melting. In many nuclear applications it is essential that certain tracer elements in steel shall be reduced to the minimum. The vacuum melting technique permits close control of the chemical composition of every melt and enables certain elements to be completely removed and others kept to the specified minimum.

Vacuum Induction Melting Unit

This unit is designed for semi-continuous operation and consists of a horizontal vacuum chamber constructed of stainless steel approximately 7½ft in diameter by 9ft long. The end of this chamber is sealed by a hinged door and the whole of the chamber and door is water cooled by copper coils, brazed to the outside of the unit. This chamber contains the h.f. induction melting coil which is designed to tilt about the pouring axis, and immediately in front of and below the furnace there is a rotary mould



"Heraeus" consumable arc vacuum melting furnace

table which allows several ingot moulds or castings to be poured from one melt. Provision is made for the observation of all stages of the process through three observation windows, each equipped with shields and wipers. The power supply for the melting is a 200 kW motor alternator set working at 400 V and 3,000 c/s.

Consumable Arc Melting

The melting furnace consists of a large vacuum-tight vessel evacuated by pumps which are capable of handling large volumes of gas at high vacuum. The actual melting is carried out in the copper crucible which forms the lower half of the furnace. An electrode is placed inside the furnace where it is welded on to the feeder rod, under high vacuum conditions. The electrode can then be driven up or down, to control the melt, by applying drive to the feeder rod. This feeder rod also carries the melting current, through sliding vacuum seals, from the electrical busbars down to the electrode.

The melt is started by striking an arc between the bottom of the electrode and a small charge placed at the bottom of the crucible. The heat generated by the arc provides sufficient heat to melt the tip of the electrode. Molten metal sprays down to form a pool which, when solidified, forms the ingot.

An electrical control unit drives the feeder rod as required by the melt. Arc gaps can be maintained within fine limits when using this unit at maximum sensitivity and it is possible to apply a current of 18,000 A to the electrode.

Power Transformers

THE British Standard "Electrical Performance of Transformers for Power and Lighting" (B.S. 171:1936) has now been revised and given the title "Power Transformers." It includes a revision of B.S. 422:1931, "Transformer Inter-Turn Insulation" which is no longer available as a separate publication.

The scope of the Standard has been extended, applying to power transformers, reactors and earthing transformers having windings insulated with Class A, B, H or C materials, with single-phase ratings of 1 kVA and above, or polyphase ratings of 2 kVA and above. Both dry-type and oil-immersed type transformers are specified. A complete section is devoted to insulation levels.

Temperature-rise limits are given and cooling methods are classified. Ratings, tappings and the marking of terminals are dealt with in considerable detail, and the general requirements for performance under external short-circuit conditions are specified. Certain external features of the transformers also receive attention. Full details of routine performance tests are given and the method by which efficiencies and losses are to be stated is laid down. Tests of impulse-voltage withstand, temperature rise and the measurement of zero phase-sequence impedance are also included.

A new British Standard Code of Practice, C.P. 1010: 1959, contains 31 pages of guidance on the loading of oil-immersed transformers to B.S. 171 with Class A insulation, and is based on their thermal characteristics and fittings. The 1927 and 1936 editions of B.S. 171 contained certain recommendations on the loading of transformers, but when the 1959 revision of that Standard was started it was decided to revise them in the light of experience and make them the subject of this Code of Practice. C.P. 1010 therefore supersedes earlier recommendations and is applicable to oil-immersed transformers supplied to past and present issues of B.S. 171.

A list of basic data is set out, including, as a basis for the recommendations, four categories of daily operating conditions associated with the permissible maximum temperature of the windings. The information is given in a series of tables and their use is illustrated by examples. One shows how a user with a transformer in service can permit the transformer to carry a load above its rated kVA without reducing its potential life. Another shows how a system planner with anticipated average and peak daily loading conditions can choose a transformer with the most appropriate kVA rating.

Copies of B.S. 171:1959 (price 20s) and C.P. 1010: 1959 (price 7s 6d) may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1.

Engineering Standards Conference

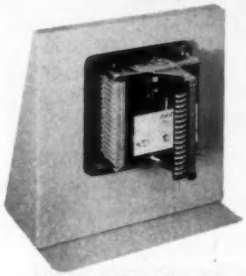
THE fifth annual conference of engineers responsible for standards will be held at the Connaught Rooms, London, on 4th June. The one-day conference will be opened this year by Lord Halsbury, president of the Institution of Production Engineers. The theme for the morning session will be the significance of standards in the national economy, their application in the individual economy and the function of a standards engineer. The afternoon session will include a review of the opinions expressed since the last conference on the question of establishing a formal association of standards engineers.

Applications for tickets (35s each) should be sent, before 21st May, to the Secretariat, I.P.E./B.S.I. Committee, British Standards House, 2, Park Street, W.1.

NEW ELECTRICAL EQUIPMENT

Withdrawable Relays

A range of withdrawable relay cases, named "Swingtest," introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, incorporate features which permit secondary injection testing to be carried out easily and quickly, and a faulty relay to be replaced rapidly, thus ensuring almost complete continuity of protection. In each relay a series of bridge contacts mounted on a contact carrier completes a circuit between two vertical rows of contacts fixed to the case and relay unit. Rotation of the bridge contact carrier through 90 degrees isolates the relay, automatically short-circuits any current transformer circuits, opens trip circuits, and mechanically unlocks the relay unit so that it can be withdrawn from the case on slides. When fully withdrawn, the relay unit can be swung round on two pivots, exposing all sides for inspection, or it can be completely removed by lifting it from the pivots.



G.E.C. withdrawable relay

To injection-test the relay unit in the case, the bridge contact carrier is rotated beyond the "withdraw" position to lock the relay firmly in the case, and a split test-plug is then inserted in the space normally occupied by the bridge contact carrier. Insertion of the test-plug completes the current transformer and tripping circuits, and the relays can be tested safely with the associated primary equipment remaining in commission.

These relays are available in five case sizes and, with the exception of the smallest size, they occupy the same panel space as the conventional flush type relays and fit into the same cut-out.

Coaxial Relays

The range of coaxial relays for switching h.f. circuits produced by LONDEX, LTD., Anerley Works, 207, Anerley Road, London, S.E.20, has been extended to include six basic types. An electromagnetic relay moves a spring contact between two fixed contacts in such a way that the impedance level remains substantially

Londex coaxial relay

constant in the paths carrying the current in the two positions. The spring contact and the two fixed contacts are mounted on the centre pins of coaxial connectors, into which floating connectors matching the external circuits are inserted. All types are d.c. operated, taking approximately 1 W at 6, 12 or 24 V, and each has silver contacts and can carry about 70 W h.f. power, provided the circuits in each direction are properly terminated.

Zener Voltage Regulators

A range of silicon zener voltage regulators, types 1S501-1S516, and silicon zener voltage reference diodes is announced by TEXAS INSTRUMENTS, LTD., Dallas Road, Bedford. The regulators are stud-mounted and cover the voltage range of 22 to 91 V in 16 steps. These regulators, which are rated at 8 W dissipation, are available with zener voltage tolerances of 5 or 10 per cent and can be supplied with anode to stud, cathode to stud, or as double anode clippers. The voltage reference diodes cover the range 3·6 to 10 V in 12 steps. They are also available with zener voltage tolerances of 5 or 10 per cent and are hermetically sealed in small molybdenum-glass sleeves.

Portable Wiring System

A wiring system called "Unyte" embodying an interchangeable selection of moulded plug-in cable units which are portable and provide temporary power and lighting supplies for building sites, etc., has been introduced by ENFIELD CABLES, LTD., Victoria House, Southampton Row, London, W.C.1.

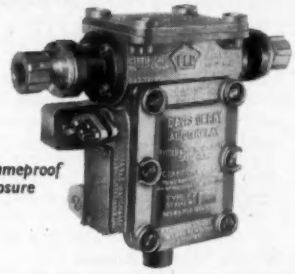
Enfield "Unyte" wiring system sections

These weatherproof units consist of cable lengths with integrally moulded plugs and sockets made from high-grade rubber or Neoprene. The main leads range from 0·007 sq in up to 0·04 sq in, 3- or 4-core, and have a heavy duty standardised moulded plug on one end and a similar socket at the other. Tee-offs for 5 A points can be fitted as required along the length, which is arranged to suit customers' individual requirements.

All main leads have the cable size clearly embossed in the moulding to facilitate installation. Extension leads are normally 5 A flexible 3-core leads for single-phase supply. The plugs connecting leads to the mains supply can be fitted with a cartridge fuse and earth pin.

Flameproof Enclosures

The range of flameproof mining equipment manufactured by JOHN DAVIS & SON (DERBY), LTD., All Saints Works, Derby, is being extended to include items for general industrial use. Flameproof enclosures can now be supplied to individual specifications for industrial situations where a gas hazard exists.

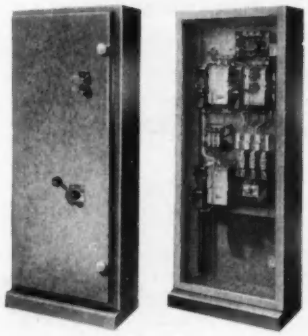


Davis flameproof enclosure

Contactor-Starters

Under the designation of type J-60, J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall, Staffs., have introduced a group of heavy-duty contactor-starters. When used as a contactor on

Crabtree J-60 star-delta starter



a 415 V 50 c/s supply the type J-60 is rated at 100 A per phase for heating loads and 60 A per phase for inductive loads, and at this voltage the direct-on starters are suitable for motors up to 40 h.p. and the auto star-delta starters for motors up to 70 h.p.

The range has been developed from a small number of standardised and interchangeable units mounted on single- or two-unit backplates, which will accommodate built-in isolating switches and h.r.c. fuses. Cast aluminium or sheet steel cases are provided, and all enclosures have gasketed covers or doors. The magnet system operates vertically, the motion being translated through 90 degrees to give horizontal closing of the main contacts, and nylon buffers are provided to absorb the shock of magnet closure. The moving contacts have a bounce duration of less than 1 millisecond, and the auxiliary contacts, which are provided with silver tips, have a moving bearing of nylon, a material also employed for the plungers of the oil-tight push-button units.

The 3-phase overload unit, which is of the compensated thermal type and is current-transformer operated, is available in two sizes, 15 to 30 A and 30 to 60 A. The triple-pole, double-break isolating switch has a continuous rating of 100 A per phase, but is capable of making and breaking currents up to 800 A at 440 V. Two auxiliary poles are available for currents of up to 5 A at 440 V. The operating handle is mechanically interlocked with the starter cover or door as standard. All wiring connections are made from the front and all components requiring periodic inspection have front access.

Shock Measurement

A portable instrument for measuring the shock received inside packages, the cushioning properties of packaging materials and also peak "g" values in vibration testing has been introduced by FERRANTI, LTD., Hollinwood, Manchester, Lancs. The instrument comprises two main units, a probe which consists of a barium titanate crystal accelerometer fitted in a metal housing connected by a screened output cable, a 12ft length of which is supplied, to an indicator unit. This incorporates a cathode follower, an a.c. amplifier, a low-pass filter with a cut-off frequency of 675 c/s and an output socket for a connection to a cathode ray oscilloscope. A double scale 3½in dial indicator is also fitted, calibrated in four ranges, 0-25, 0-100, 0-250, 0-1,000 "g." The minimum value of "g" registered is 3, and vibration readings from 8 to 750 c/s can be obtained. The instrument operates from a 230-250 V, 50 c/s supply but can also be supplied suitable for operation from a 105-120 V, 50-70 c/s supply if required.

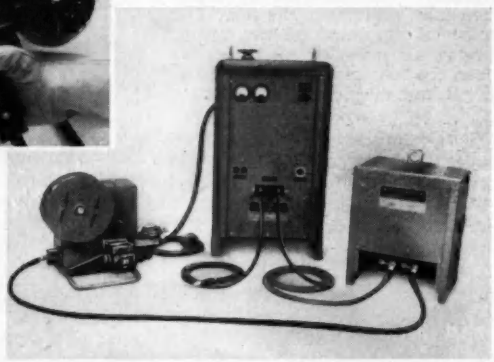
Ferranti peak accelerometer

Switch Socket

A double pole switch socket outlet to B.S. 2814, rated at 13 A, to fit into boxes having B.S. 1299 fixing centres, is announced by NETTLE ACCESSORIES, LTD., Warren Street, Stockport, Cheshire. The cover and base are of non-track urea formaldehyde, and the rearward projection of the base has been minimised to enable the socket to be wired into a 1in deep box. A model incorporating a neon indicator lamp visible through a transparent window in the cover is available. The lamp is connected between the live terminal on the appliance side of the switch and the earth terminal and will thus indicate whether earth continuity is unbroken.

Nettle switch socket

Rowen-Arc 500 A welding equipment and (inset) the "light" series hand gun



Arc Welding Equipment

A new division of Rubery Owen & Co., Ltd., "Rowen-Arc," has been formed at Longford Works, Blackhorse Road, Longford, Coventry, to manufacture and market welding equipment developed by the Westinghouse Electric Corporation of Buffalo, New York. The Rowen-Arc process utilises a portable hand gun with a continuous electrode wire, the arcing area being protected from contamination by a gas shield, usually carbon dioxide for mild steel welding and argon for aluminium alloys and stainless steel.

There are two types of gun. The "light" series has a self-contained reel of wire giving up to 45 minutes' continuous welding, wires from $\frac{1}{16}$ to $\frac{3}{64}$in diameter being fed at speeds of 120-350 in/min and wires down to 0·03in diameter at speeds from 250-750 in/min. The "medium" series gun, which is fed with 0·4-0·93in diameter wire at speeds of 50-400 in/min from a reel in a separate control unit, has a built-in wire feed speed control, start-stop weld switch and inching button, and a water cooled gas nozzle. Two special nozzles for spot welding are available for use with this gun—an air cooled type fitted for short time duration work, and a water cooled adaptor nozzle more suited to production work where the duty cycle is high.

The control unit incorporates a single electronic valve and operates from a 110 V single-phase a.c. supply. Constant wire feed speed is maintained by drive rollers powered by a $\frac{1}{12}$ h.p. d.c. geared motor and the reel hub can be braked to maintain uniform wire tension. Plug-in power and welder control cables are provided and a hinged panel gives easy access to the gas and water control solenoids, water pressure switch, current relay and wire feed braking adjustments. The control unit for automatic and semi-automatic welding includes an electronic timer. An inching speed switch also provides automatic purging of the gas and water lines prior to the initiation of each welding time cycle.

Two power units are available, both of the constant potential rectifier type. The "R.C.V." model is suitable for connection to a single-phase input and is rated for an 11-44 V, 200 A d.c. output, while the "R.C.P." model is arranged for a three-phase input and is rated for a 14-40 V d.c. output at 500 A. Both models have a stepless output voltage control.

Airfield Electronic Equipment

COMMUNICATION AND CONTROLLED LANDING SYSTEMS

AT a meeting of the Association of Supervising Electrical Engineers held at the Institution of Electrical Engineers last week a paper was presented by Mr. E. H. Bruce-Clayton on "The Electronic Equipment of Airfields."

Communication between an airport and the aircraft using it, he said, was now conducted almost exclusively by voice, normally in the v.h.f. band between 118 and 132 Mc/s. V.h.f. radio telephone equipments used at an airport were fairly conventional receivers and amplitude modulated transmitters, of the order of 10-50 W output. The v.h.f. radio telephone was also used to link the various mobile vehicles working on the airport, re-fuellers, towing tractors, fire fighting, police and passenger service vehicles. Since it was necessary to maintain a record of these voice communications, it was common to install tape recorders on all channels.

Communication between airports, traffic control centres, meteorological forecasting stations, etc., was carried out by a world-wide communication service known as the Aeronautical Fixed Telecommunications Network, using land lines or point-to-point radio links. Morse code had been replaced by a more rapid method and teleprinter circuits working at 66 w.p.m. were now replacing nearly all morse circuits. The technique adopted by international agreement for radio teleprinter communications employed frequency shift keying. The transmitter frequency was shifted a few hundred cycles above or below the nominal frequency coincident with the marking and spacing impulses generated by the teleprinter. At the receiving station these frequency shifts were detected and reconverted into impulses to operate a second teleprinter.

Mr. Bruce-Clayton then dealt with the various electronic facilities for which the aerodrome controller was responsible. Aircraft might be able to operate in weather conditions which prevented the controller having a clear view of the airfield, and radar equipment known as airfield surface movement indicators were used to prevent collision between aircraft and/or ground vehicles, frequencies of the order of 34,000 Mc/s being employed to give the very high discrimination necessary. Medium- and short-range high discrimination radar was also used for the control of aircraft in flight, supplying the controller with information referring to aircraft range and bearing.

Navigation and Landing Aids

Under poor visibility conditions an aircraft must be accurately manœuvred into a suitable position from which the final approach could be made, and then the approach, which was closely controlled in azimuth and elevation, must be made down to a point at which the landing could be completed by visual reference. Several equipments gave a continuously available navigational reference in the cockpit, including V.O.R.—v.h.f. omni-directional radio beacon—which enabled an aircraft to make a definite track to or from a transmitting beacon. Distance measuring equipment (D.M.E.) consisting of a receiver and a pulse transmitter on the ground and a transponder and display system in the aircraft had been adopted as a supplement to V.O.R. to provide a distance measurement, enabling the aircraft's position to be fixed.

The system adopted by international agreement to control the descent to within a few hundred feet of the runway was the instrument landing system—I.L.S. Two separate ground components, the localiser and glide-path equipment, radiated signals which were detected and interpreted in the airborne equipment. The localiser provided a guidance in azimuth, radiating a signal pattern consisting of two elongated lobes which overlapped along a line coincident with the runway centre line. The airborne equipment detected whether it lay in the left- or right-hand lobe or in the overlap and displayed the result by a left-right indicator for the pilot. The glide-path equipment provided a similar radiation pattern with the overlap directed upward at the approach angle to the ground. On the same pilot's indicator a second needle showed the aircraft's position in relation to the glide path. Two marker beacons on the extended centre line of the runway about four and one miles from the runway threshold transmitted a narrow vertical signal causing a lamp to be illuminated in the cockpit, giving the pilot a check on his progress down the glide path.

Ground Control

In the ground controlled approach system—G.C.A.—the progress of an aircraft's approach was constantly monitored by controllers instructing the pilot by radio-telephony. The final descent was under the control of the precision approach radar, which comprised two separate radar equipments, each radiating a narrow fan-shaped beam, one scanning in azimuth and one in elevation. The responses from the aircraft were displayed on two cathode-ray tubes marked with the correct approach path, with which the aircraft's response was compared.

Meteorological information was largely transmitted and received by the conventional communication channels. Equipment had been used for some time, however, which transmitted a facsimile picture of the forecast chart. Storm warning and wind finding radar was used for the direct observation of current weather conditions. The storm warning equipment operating in the 9,000 Mc/s band displayed the responses obtained from water droplets suspended in the atmosphere, and the wind finding radar observed the progress of a balloon from which a metallic reflector was suspended.

In referring to future trends, Mr. Bruce-Clayton considered various electronic equipments which were now in an advanced state of development. Equipment for the completely automatic landing of an aircraft had been used for some time, incorporating the instrument landing system automatically coupled to the auto-pilot to bring the aircraft down to within 300ft of the ground. At this point magnetic leader cables laid in the ground and extending outwards about a mile from the runways were used for azimuth guidance, and at a height of about 100ft highly sensitive radio altimeters in the aircraft controlled the final approach and closed the throttles. Other developments would include the automatic identification of aircraft on radar displays by the transmission of code signals from an airborne equipment, and the automatic signalling of standard routine messages.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1954

11002. Besson & Robinson, Ltd., and Besson, A. P.—Electromagnetic relays. 14th July, 1955. (Cognate application 27273, 21st September, 1954.) (812546.)

25010. British Broadcasting Corporation.—Radio transmitter systems. 26th August, 1955. (812547.)

7541. General Electric Co., Ltd.—Apparatus for indicating the rate of variation of a quantity. 15th March, 1956. (812686.)

8312. General Electric Co., Ltd.—Electric lighting fittings. 3rd May, 1956. (812687.)

11395. Electric & Musical Industries, Ltd.—Arrangements for use with cathode-ray display tubes. 20th April, 1956. (812548.)

12771. National Research Development Corporation.—Semiconductor signal translating devices. 23rd April, 1956. (812550.)

14601. English Electric Co., Ltd.—Electric switchgear. 16th May, 1956. (812691.)

21726. General Electric Co.—Clothes washing machines. 27th July, 1955. (812552.)

21816. General Motors Corporation.—Transistors. 28th July, 1955. (812554.)

23857. Delapena & Son, Ltd.—Apparatus for heating toothed or serrated portions of articles by high frequency induction heating. 4th August, 1955. (813113.)

25415. Dubilier Condenser Co. (1925), Ltd.—Electrical capacitors. 5th September, 1955. (812555.)

26079. Goldstaub, H. H.—Electrical heating mantles. 11th December, 1956. (812694.)

27600/1. Volex Electrical Products, Ltd., and Hughes, J. G. K.—Electric plug-and-socket couplings. 26th September, 1955. (812889/90.)

28751. Westinghouse Electric International Co.—Gas turbine power plants. 10th October, 1955. (812557.)

30629. Stone & Co. (Deptford), Ltd., J.—Electromagnets, particularly for electromagnetic regulators. 22nd October, 1956. (812558.)

32176. Cole, Ltd., E. K., and Davis, R. G.—Apparatus for comparing the intensities of radiation from two radioactive sources. 7th November, 1955. (812952.)

33541. C.T. Electrical Controls, Ltd.—Electric circuit-breaker. 23rd November, 1955. (812622.) 33594. Electric power distribution system. 23rd November, 1955. (812623.) 34068. Thermally operated electric switching mechanisms. 28th November, 1955. (812624.)

36550. British Insulated Callender's Cables, Ltd.—Junction boxes for electric cables. 19th December, 1956. (812559.)

1955

13773. British Thomson-Houston Co., Ltd.—Control apparatus for cathode-ray tubes. 27th June, 1956. (812953.)

19176. Bouthillon, L.—Memory devices employing semiconductors. 1st July, 1955. (812821.)

21690. Hi-Ro Heating Corporation.—Method and apparatus for infra-red radiant heating. 27th July, 1955. (813101.)

23106. Varian Associates. — Velocity modulation electron tube apparatus. 10th August, 1955. (813103.)

23440. Accumulatoren-Fabrik A.G.—Manufacture of electrodes for alkaline accumulators. 15th August, 1955. (813119.)

23847. Skillman & Co. Pty., Ltd., T. S.—Carrier supply circuit for carrier telephone systems. 18th August, 1955. (812959.)

26749. Crompton Parkinson, Ltd.—Manufacture of plates for lead-acid secondary batteries. 19th September, 1956. (812920.)

33353. Burndy Corporation.—Copper-to-aluminium electric connector. 22nd November, 1955. (813121.)

1956

108. Kemp, J. A. (Allgemeine Telefonfabrik G.m.b.H.).—Circuit arrangement for telephone installations with line finders. 2nd January, 1956. (812966.)

293. Zavody V.I. Lenina, Narodni Podnik, Chadzi, S., and Seiber, J.—Driving arrangements for electrically propelled vehicles. 4th January, 1956. (812931.)

450. Telephone Manufacturing Co., Ltd.—Electrical junction boxes. 1st April, 1957. (812932.)

1113. Telecommunications Radioelectriques et Telephoniques.—Electrical apparatus for railway signalling. 12th January, 1956. (812629.)

2057. British Insulated Callender's Cables, Ltd.—Multiple contact two-part electric couplings. 21st January, 1957. (812933.)

2493. Philips Electrical Industries, Ltd.—Electric discharge tubes for detecting radiation. 25th January, 1956. (812969.)

3190. General Railway Signal Co.—Electronic code communication system. 1st February, 1956. (812754.)

4455. Plessey Co., Ltd.—Electromagnetic relay. 11th February, 1957. (813123.)

4497. Standard Telephones & Cables, Ltd.—Machine control. 13th February, 1956. (812617.)

5630. National Research Development Corporation.—Analogue-to-digital convertors. 21st February, 1957. (812604.)

5659. Mechanical Products, Inc.—Electric circuit-breakers. 23rd February, 1956. (812971.)

5718. Decca Record Co., Ltd.—Radar apparatus. 23rd May, 1957. (812799.)

5833. General Electric Co.—Dynamic braking control circuits for electric traction motors. 24th February, 1956. (812698.)

7641. Alden, M.—Electrode recording apparatus, particularly for facsimile receivers. 12th March, 1956. (812976.)

8845. General Electric Co.—Dynamo-electric machines. 21st March, 1956. (812606.)

8849. Siemens Edison Swan, Ltd.—Polarised electromagnetic devices. 8th March, 1957. (812630.)

9862. General Electric Co.—Temperature compensated transistor amplifier. 29th March, 1956. (812977.)

10889. Brown, Boveri & Co., Ltd.—Circuits for operating alternators in series. 10th April, 1956. (812937.)

12095. Gaudillere, P. C.—Radio position determination systems. 20th April, 1956. (813126.)

13128. Sandon, Ltd.—Rotary electric switches. 29th July, 1957. (813127.)

13528. B.M. Lamps, Ltd.—Electric battery lamps. 1st May, 1957. (Cognate application 37161, 5th December, 1956.) (Addition to 742804.) (812980.)

13541. Marconi's Wireless Telegraph Co., Ltd.—Electron discharge tube circuit arrangements. 14th February, 1957. (812635.)

13865. Philips Electrical Industries, Ltd.—Solid-state image intensifiers. 4th May, 1956. (812637.)

14447. Kokusai Denshin Denwa Kabushiki Kaisha.—Radio direction finder. 9th May, 1956. (813058.)

14474. Dreyfus, J. A.—Electrical switch contact devices having adjustable blade contacts. 9th May, 1956. (812981.)

14477/8. Pilkington Bros., Ltd., Wynne, H. C., and Yates, D. J.—Method of and apparatus for manufacturing face plates of cathode-ray tubes. 7th May, 1957. (812899/900.)

15276. Brown, Boveri & Cie. A.G.—Method for the production of high voltage insulation on electrical conductors and high voltage insulated electrical conductors produced by this method. 16th May, 1956. (813129.)

15385. Plessey Co., Ltd.—Noise controlled switching means for wireless receiving apparatus. 22nd July, 1957. (812608.)

15449. Siemens & General Electric Railway Signal Co., Ltd.—Electric light signal repeating systems. 17th May, 1957. (812609.)

16762. Marconi's Wireless Telegraph Co., Ltd.—Echo sounders. 22nd February, 1957. (812638.)

16956. Revo Electric Co., Ltd.—Electric street lighting fittings. 17th May, 1957. (812761.)

16999. Standard Telephones & Cables, Ltd.—Machine control. 13th February, 1956. (Divided out of 812617.) (812618.)

17338 and 35281-2. Western Electric Co., Inc.—Electrical circuits employing ferro-electric condensers. 5th June and 19th November, 1956. (812619/21.)

18173. United States Steel Corporation.—Control systems for electric motors driving rolling mills. 12th June, 1956. (813130.)

18465. Watliff Co., Ltd.—Commutators of dynamo-electric machines. 4th June, 1957. (812712.)

18565/6. Westinghouse Electric International Co.—Induction instruments or devices. 15th June, 1956. (812903/4.)

21543. United Kingdom Atomic Energy Authority.—Fuel elements for nuclear reactors. 3rd July, 1957. (813131.)

21597. Siemens Edison Swan, Ltd.—Translating apparatus as employed in automatic telephone and like systems. 12th July, 1957. (812566.)

22414. Pohl, H.—Clip for fixing conduits, cables and the like. 19th July, 1956. (812941.)

23457. Philips Electrical Industries, Ltd.—Amplitude limiters. 30th July, 1956. (812720.)

23664. Thompson Nuclear Energy Co., Ltd., A.E.I., J.—Fuel elements for nuclear reactors. 11th July, 1957. (813132.)

23989. Standard Telephones & Cables, Ltd.—Electrolytic capacitor. 3rd August, 1956. (812989.)

25010. Sylvania Electric Products, Inc.—Lamp bulb feeder. 15th August, 1956. (812802.)

26304. Hunt (Capacitors), Ltd., A. H.—Electrical capacitors. 28th August, 1957. (813065.)

27238. Sylvania Electric Products, Inc.—Production of conductive patterns. 5th September, 1956. (813140.)

27920. General Electric Co.—Electron gun structures for cathode-ray tubes. 12th September, 1956. (812577.)

28678. General Electric Co.—Electric switching devices. 19th September, 1956. (812992.)

28931. Standard Telephones & Cables, Ltd.—Railway signalling equipment. 21st September, 1956. (812730.)

29405. Erie Resistor Corporation.—Printed circuit. 26th September, 1956. (Addition to 725115.) (812772.)

29849. M.O. Valve Co., Ltd.—Joints between metal bodies and ceramic bodies. 1st October, 1957. (812944.)

30801. Short Bros. & Harland, Ltd.—Direct coupled amplifiers. 9th October, 1957. (812774.)

[*Continued on page* 883

NEW PATENTS (*Continued*)

31332. Collins Radio Co.—Vertical speed computer and altitude control. 15th October, 1956. (812995.)

31680. Automatic Telephone & Electric Co., Ltd.—Electrical component mounting arrangements. 2nd October, 1957. (812731.)

31848. Revo Electric Co., Ltd.—Terminal arrangement for a combined switch and fuse box. 4th October, 1957. (812645.)

35490. Texas Instruments, Inc.—Rectifier units. 20th November, 1956. (812999.)

35782. Texas Instruments, Inc.—Full wave rectifier structure and method of preparing same. 22nd November, 1956. (812739.)

35954. Beltrami, A.—Electronic image transmitting system. 23rd November, 1956. (812584.)

37097. General Electric Co., Ltd.—Electric circuit arrangements including cathode-ray tubes. 4th December, 1957. (812778.)

37427. Plessey Co., Ltd.—Permanent magnets for loudspeakers. 6th December, 1957. (812481.)

37943. General Motors Corporation.—Electric motor insulation. 12th December, 1956. (812743.)

38288. Standard Telephones & Cables, Ltd.—Transmission measuring sets for electric communication circuits. 14th December, 1956. (812588.)

39451. Standard Telephones & Cables, Ltd.—Arrangement for limiting the interference noises and voltage peaks in a sweep transformer, particularly of television receivers. 28th December, 1956. (812781.)

39617. Cincinnati Milling Machine Co.—Electric spark discharge type drilling and boring machines. 31st December, 1956. (813071.)

1957

554. S. & C. Electric Co.—Trailers for electric circuit interrupters. 7th January, 1957. (812488.)

1008. United Kingdom Atomic Energy Authority. — Electromagnetic interaction pumps. 6th January, 1958. (813005.)

2296. Rochar Electronique S.A.—Electronic bistable devices. 22nd January, 1957. (813008.)

2507. Collins Radio Co.—Stabilised variable oscillator system. 23rd January, 1957. (813074.)

3768. Philips Electrical Industries, Ltd. —Indicators for use in radar apparatus. 4th February, 1957. (813095.)

5454. Babcock & Wilcox Co.—Vapour generating unit. 18th February, 1957. (812500.)

5478. General Radio Co.—Electrical bridge. 18th February, 1957. (813076.)

6048. Standard Telephones & Cables, Ltd.—Electrical equipment mounting arrangement. 22nd February, 1957. (812854.)

6063. Egysult Izzolampa es Villa-Mossagi R.T.—Cathode-ray tube. 22nd February, 1957. (Addition to 809914.) (812805.)

7264. Westinghouse Electric International Co.—Electric circuit interrupters. 5th March, 1957. (813077.)

7752. Veb. Vereinigte Porzellanwerke Koppelsdorf.—Semiconducting glazes. 8th March, 1957. (812858.)

8461. Philips Electrical Industries, Ltd. —Television and like signalling systems and signal transmitters. 14th March, 1957. (813096.)

8790. Veb. Elektrogeratewerk Suhl.—Snap-action electric switch for small motors. 18th March, 1957. (812860.)

9468. Western Electric Co., Inc.—Manufacture of electrical capacitors. 22nd March, 1957. (812596.)

10187. Sperry Rand Corporation.—Electron gun for tubular beam. 28th March, 1957. (812597.)

10708. Westinghouse Electric International Co.—Automatic electric circuit-breakers. 2nd April, 1957. (813097.)

11744. Philips Electrical Industries, Ltd. —Metallic housings for an electric component part. 10th April, 1957. (812599.)

12064. Telefonaktiebolaget L. M. Ericsson.—Electromagnetically operated oscillating armature devices. 12th April, 1957. (812600.)

13060 and 19474. C.T. Electrical Controls, Ltd.—Electric circuit-breaker. 23rd November, 1955. (Divided out of 812623.) (812625/6.)

16247. Telefunken G.m.b.H.—Transistor circuit arrangements. 22nd May, 1957. (812518.)

17106. Sperry Products, Inc.—Transducers of ultrasonic waves. 20th March, 1956. (Divided out of 813039.) (813040.)

17340. Westinghouse Electric International Co.—Protection of shunt capacitor banks for a.c. lines. 31st May, 1957. (812672.)

17939. Etablissements E. Jaeger.—Means for exciting the coils of electromagnetic clutches. 5th June, 1957. (812520.)

19303. Philips Electrical Industries, Ltd. —Glow discharge tubes comprising an auxiliary anode. 19th June, 1957. (812655.)

20517. Minneapolis-Honeywell Regulator Co.—Apparatus having flexible leads between relatively rotatable members. 28th June, 1957. (812875.)

21913. Decca Record Co., Ltd.—Radar apparatus. 7th October, 1957. (812877.)

22009. General Electric Co.—Polyphase induction-type motors. 11th July, 1957. (812525.)

23394. Hackbridge & Hewittic Electric Co., Ltd., Winter, J. R., and West, J. A.—Electric current transfer contact assemblies. 25th September, 1957. (812878.)

24983. Addison Electric Co., Ltd.—Temperature measuring device. 8th August, 1957. (812674.)

25944. Minneapolis-Honeywell Regulator Co.—Control motors for gyroscopes. 16th August, 1957. (812662.)

28555. Collins Radio Co.—Starting circuit for synchronous motor. 10th September, 1957. (813087.)

30329. Standard Telephones & Cables, Ltd.—Circuit arrangement for the blanking of the horizontal flyback in television receivers. 27th September, 1957. (812865.)

30497. Ruben, S.—Electric current producing cell. 30th September, 1957. (812669.)

31581. Mullard, Ltd.—Radio valves. 9th October, 1957. (812868.)

33039. Brown, Boveri & Cie. A.G.—Heterogeneous nuclear reactors. 23rd October, 1957. (812809.)

33621/2/3. Varian Associates.—Velocity modulation electron tube apparatus. 10th August, 1955. (Divided out of 813103.) (813104/5/6.)

33788. Gould-National Batteries, Inc.—Lead acid storage batteries. 29th October, 1957. (812537.)

1958

3001. Hoover, Ltd.—Suction cleaners. 29th January, 1958. (812886.)

3131. Unternehmungen der Eisen- und Stahlindustrie A.G. für.—Apparatus for charging accumulators. 30th January, 1958. (812885.)

Amended Specifications

751256. Siemens-Schuckertwerke A.G.—Cooling high voltage electric machines.

789257. United Kingdom Atomic Energy Authority.—Gas-cooled nuclear reactors.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 11th MAY

Bournemouth.—Grand Hotel, Firvale Road, 7.15 p.m. A.S.E.E. Bournemouth Branch. Annual general meeting.

London.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Trends in the Teaching of Electric Machine Theory in the United States," opened by P. L. Alger.

MONDAY, 11th MAY to WEDNESDAY, 13th MAY

London.—Central Hall, Westminster, S.W.1. Institution of Chemical Engineers, Society of Instrument Technology, and British Computer Society. Joint symposium on "Instrumentation and Computation in Process Development and Plant Design."

TUESDAY, 12th MAY

Bristol.—University Engineering Laboratories, 7 p.m. I.E.E. Bristol Graduate and Student Section. Annual general meeting.

Cardiff.—Angel Hotel, 7.30 p.m. A.S.E.E. South Wales Branch. "General Layout of 600 MW Generating Station at Aberthaw," by J. W. Hull.

London.—Savoy Hotel, W.C.2, 12.30 for 1 p.m. British Electrical Development Association. Annual luncheon, followed by annual general meeting.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon.

Manchester.—Central Library, St. Peter's Square, 6.30 p.m. Society of Instrument Technology, Manchester Section. Annual general meeting followed by "Temperature Measurement with Resistance Thermometers," by C. K. Massey.

Reading.—Electricity Board Demonstration Room, Market Square, 7.15 p.m. A.S.E.E. Reading and District Branch. "Transformer Construction and Design," by R. A. Grierson.

TUESDAY, 12th MAY to THURSDAY, 14th MAY

Folkestone.—Public Transport Association. Annual conference.

WEDNESDAY, 13th MAY

Birmingham. — Engineering Centre, Stephenson Place, 7.30 p.m. A.S.E.E. Birmingham Branch. "Distribution Networks in Towns and Cities," by R. H. Rockliffe.

Bradford.—Midland Hotel, 7.30 p.m. A.S.E.E. Bradford Branch. "Electrics at B.B.A., Ltd.", by D. Kirkby.

Glasgow.—39, Elmbank Crescent, 7.30 p.m. A.S.E.E. Glasgow Branch. Annual general meeting.

Liverpool.—I.E.S. Leeds Centre. Visit to s.s. "Empress of Britain." Address by F. W. Evans on the "Lighting of Ships."

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Electronics and Communications Section. "The Application of Statistical Techniques to the Electronic Valve Industry," by E. G. Rowe.

London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers. "Improving Communication Techniques—What have Engineers to Learn from Information Theory?" by Professor D. Gabor.

Manson House, Portland Place, W.1, 6 p.m. Society of Instrument Technology, Data Processing Section. Annual general meeting followed by "A Multipoint Digital Strain-Gauge Recorder," by J. R. Sturgeon.

THURSDAY, 14th MAY

Cardiff.—Park Place, 6 p.m. South Wales Institute of Engineers. Paper on Switchgear.

London.—At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Institution of Electrical Engineers. Annual general meeting followed at 6.30 p.m. by "Conceivable Future of Telecommunications," by Professor E. C. Cherry.

Ryde (I. of W.).—Ryde Castle Hotel, 6.30 p.m. I.E.E. Southern Centre. "Indoor Lighting Systems—A Practical Comparison of Light Output and Costs," by E. Beaumont.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Azores.—Federation of Municipalities of S. Miguel, Ponta Delgada. 1st June. 30/10 kW substation. (E.S.B. 9703/59. Ten/38685.)*

Belfast.—Corporation. 29th May. Electrical stores for ten months from 1st July next. (See this issue.)

Ceylon.—Tender Board, Ministry of Transport and Works, Colombo. 20th May. Electric lamps. (E.S.B. 10486/59. Ten/38831.)*

Chelmsford.—Corporation. 26th May. Group "A" street lamps. (See this issue.)

Dublin.—15th May. Electrical installation in proposed convent at Bon Secours Hospital, St. Joseph's, Glasnevin. J. V. Tierney & Co., consulting engineers, 15/16, Duke Street, Dublin.

Durham.—County Council. 23rd May. Electric lamps and miscellaneous appliances for the year ending 31st August, 1960. (See this issue.)

Gosforth.—U.D.C. 13th May. Street lighting equipment. (See this issue.)

India.—Director General of Supplies and Disposals, New Delhi. 19th May. Cadmium insulated copper wire. (E.S.B. 10407/59. Ten/38798.)* 20th May. Lead sleeves. (E.S.B. 10405/59. Ten/38799.)* 12th June. High-lift pumping sets with electrical switchgear and accessories. (E.S.B. 10404/59. Ten/38840.)*

India Supply Mission. 132 kV and 25 kV instrument transformers and cables for Damodar Valley Corporation. (See this issue.)

Iran.—Sugar Co. of the Plan Organisation, Teheran. 27th June. Electrical measuring instruments. (E.S.B. 10211/59. Ten/38739.)*

Ministry of Posts and Telegraphs, Teheran. 17th May. 5,000 telephones. (E.S.B. 10383/59. Ten/38865.)*

Isle of Axholme.—R.D.C. 21st May. Pumping plant for Epworth sewerage scheme (Contract No. 2). John H. Haiste & Partners, Council's consulting engineers, Belmont House, 20, Wood Lane, Headingley, Leeds, 6.

Lebanon.—Ministry of Public Works, Beirut. 13th May. Substation equipment, including lightning arrestors, disconnecting switches, transformers, ammeters, insulators, circuit-breakers, watthour meters, fuses, etc. (E.S.B. 9848/59/I.C.A. Ten/38715.)*

Llanelly.—Corporation. 30th May. Cable laying and connections for new street lighting. (See this issue.)

Manchester.—City Housing Department. 27th May. Electrical installations in maisonnettes, bungalows and houses. (See this issue.)

New Zealand.—Wellington Corporation. 25th May. 3,000 a.c. watthour meters. (E.S.B. 10341/59. Ten/38769.)* 150 watthour meters. (E.S.B. 10342/59. Ten/38768.)*

Rhodesia and Nyasaland.—Town Clerk, Umtali. 13th May. L.v. oil circuit-breakers. (E.S.B. 9755/59. Ten/38698.)* Distribution pillars. (E.S.B. 9751/59. Ten/38688.)*

South Africa.—Union Tender Board, Pretoria. 20th May. Amplifiers and loudspeakers. (E.S.B. 10234/59. Ten/38746.)* 29th May. Variable frequency oscillators. (E.S.B. 10238/59. Ten/38745.)*

Johannesburg City Council. 18th May. Electric cables. (E.S.B. 10772/59. Ten/38857.)*

Uruguay.—Usinas Electricas y los Telefonos del Estado. 2nd June. Telephones and accessories. (E.S.B. 10511/59. Ten/38818.)* 3rd June. Conductors. (E.S.B. 10512/59. Ten/38830.)* 4th June. Bare copper conductors and accessories. (E.S.B. 10513/59. Ten/38819.)* 5th June. Conductors. (E.S.B. 10514/59. Ten/38829.)* 10th June. Armoured cables and accessories. (E.S.B. 10516/59. Ten/38820.)*

Vietnam.—Central Purchasing Authority, Saigon. 29th May. Telephone apparatus, including wall boards and intercommunication sets. (E.S.B. 9954/59/I.C.A. Ten/38732.)*

West Hartlepool.—Corporation. Renewal of electrical installations at Jesmond Road and Park Road Schools. A. G. Sinclair, borough architect.

Willenhall.—U.D.C. 15th May. Street lighting equipment. J. R. Riding, clerk, Town Hall.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Enfield.—Legal and General Purposes (Civic Centre) Sub-Committee. Recommended. Electrical contract for stage 1 of the Civic Centre scheme (£8,713).—Troughton & Young.

London.—Metropolitan Water Board Works and Stores Committee. Indoor low-voltage d.c. switchboard for Walton pumping station (£4,075).—Bertram Thomas (Engineers).

Stockport.—Corporation. Electrical installation work at the Court House (£2,703).—Hallams (Electrical Contractors).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Boston.—First phase of new primary school, Woad Farm estate (£12,000); county architect, Boston.

Cambridge.—Pumping station for West Ouse Drainage Board; J. L. Kier & Co., Ltd., Setch, King's Lynn.

Carlisle.—Houses (14), Carlton Gardens; J. Millar & Sons, builders, 15, London Road, Carlisle.

Chelmsford.—Fifteen-storey block of flats, Melbourne Park; borough surveyor.

Cheltenham.—Three-storey flats (27), Devon Avenue/Alstone Lane site; borough surveyor, Municipal Offices.

Chingford.—Houses (40), Hawkwood Crescent; Clive G. Dennis, town clerk, Town Hall, E.4.

Chippenham.—Houses (150), Hungerdown Lane site; borough engineer, The Old Palace, Market Place.

Clare.—Houses (29); J. Allpress, clerk, Stonehall, Clare, Suffolk.

Coleshill.—Workshops; British Pleuger Submersible Pumps, Ltd., Station Road.

Compton.—Downs Secondary Modern School; J. Smallbone & Sons, Ltd., builders, Streatley, Reading.

Crook.—Houses (80), Watergate estate and Sunnybrow; Page, Son and Hill, architects, 75, King Street, South Shields.

Croydon.—Fire station and administrative block; borough engineer.

Cumberland.—Additions to Newton Rigg Farm School, Penrith (£23,000); J. H. Haughan, county architect, Portland Square, Carlisle.

Darlington.—R.C. church at Cockerton; Blackett & Son, Ltd., builders, 63, Bondgate, Darlington.

Dawlish.—Ward unit, Langdon Hospital; K. W. F. Harris, architect, 27, Tyndalls Park Road, Clifton, Bristol.

Dundee.—Houses (94), off Camperdown Road; Scottish Special Housing Association, Ltd., 15/21, Palmerston Place, Edinburgh, 12.

East Barnet.—Houses (65), Pine Road development area, N. 11; engineer and surveyor, Town Hall, Station Road, New Barnet, Herts.

Hartlepool.—Factory additions for Paragon, Ltd.; Middleton & Co., builders, Sunderland.

R.C. school, King Oswy Drive; J. W. Henderson & Co., Ltd., builders, Church Road, Stockton.

Huddersfield.—Floral hall at Greenhead Park (£95,000); borough architect, High Street Buildings.

Leicester.—Phase 1 of new Goldhill Boys' School, Knighton Lane; city architect.

London.—Flats (112), Austin Road, Battersea; M. J. Gleeson, Ltd., Haredon House, London Road, North Cheam.

Laboratory block, Chiswick; Chas. Booth, Ltd., 45, Hornsey Road, N.7.

Home for aged, Greenlaw Street, Woolwich (£104,510); Architects' Department, County Hall, Westminster Bridge, London, S.E.1.

Loughborough.—New gymnasium (first phase) and teaching block at Martin Hall, Loughborough Training College (£25,000); county architect, Leicester.

Lymington.—Town hall, civic and administrative buildings, Stanford Hill; borough engineer.

Maidenhead.—Works extensions; Taylowe, Ltd., Malvern Road, Furze Platt.

Maidstone.—Extenions, West Kent General Hospital; Thomas Mitchell & Partners, architects, 20, Bedford Square, W.C.1.

North Riding.—Offices at Guisborough for C.C. (£22,000); Middleton & Co., builders, Blackpool.

Redhill.—Flats (36), The Dome estate; Heber Davies, town clerk, Town Hall, Reigate.

Rotherham.—Houses (138), Kimberworth Park estate; John S. Wall, town clerk, Municipal Offices.

Shepperton.—Hostel for aged persons, Manygates Lane; W. S. Try, Ltd., High Street, Cowley, Uxbridge.

Smethwick.—Five-storey extension, Chance Technical College; Walter W. Atkinson, architect, 4, Raymond Buildings, Gray's Inn, London, W.C.1.

Southampton.—Dormitory and communal buildings at Warsash (£210,000) for the University School of Navigation; Richard Sheppard, Robson & Partners, architects, 5, Southampton Place, London, W.C.1.

Extensions to physics department of University; Gutteridge & Gutteridge, architects, 45, Westwood Road, Southampton.

Swimming baths, Western Esplanade; L. G. Mouchel & Partners, consulting engineers, 38, Victoria Street, London, S.W.1.

Stockton-on-Tees.—Housing developments on 13½ acres of land at Darlington Lane, Norton; Moore & Cartwright, Ltd., builders, High Street, Norton.

Tynemouth.—Flats (40), Addison Street, Vicarage Street, and Coronation Street; borough engineer, 16, Norhumberland Square, North Shields.

Home for old people (£69,000); Castles, Ltd., contractors, Tynemouth Road, Tynemouth.

Walsall.—Houses (169), Orlando Street redevelopment area, with electric underfloor heating; M. E. Habershon, borough engineer, Town Hall.

Watford.—Offices and showrooms; S. Hille & Co., Ltd., St. Albans Road.

Wellington (Salop).—Factory extension (£250,000); British Sugar Corporation, Ltd., Allscott.